

SUPER FAMICOM DOCUMENTATION

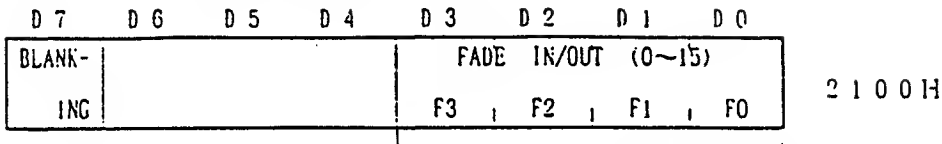
SFX02

**REGISTER
(PPU)**



A 1.000.000 BOYS A.K.A MEGABOYS PRODUCE

ADDRESS : 2100H
 NAME : INIDISP
 CONTENTS : INITIAL SETTINGS FOR SCREEN

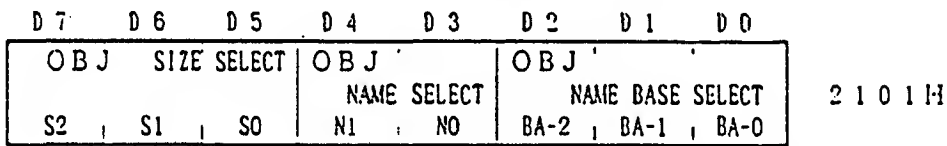


SCREEN BRIGHTNESS : Determine the Screen Brightness (16-Stages)

F3	F2	F1	F0	BRIGHTNESS
1	1	1	1	BRIGHT
1	1	1	0	
0	0	0	0	DARK

BLANKING : FORCED BLANKING
 0 : NON-BLANKING
 1 : BLANKING

ADDRESS : 2101H
 NAME : OBJSEL
 CONTENTS : OBJECT SIZE & OBJECT DATA AREA DESIGNATION



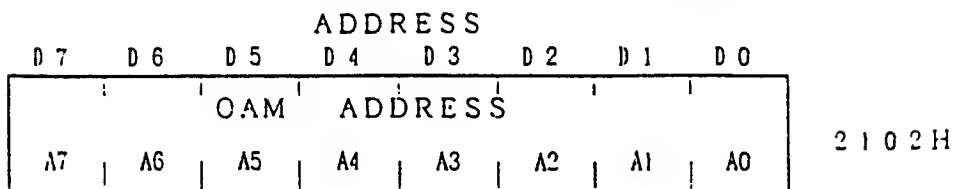
OBJECT BASE ADDRESS (UPPER-3 BIT)
 : Designate the segment (8K-word/segment) address which the OBJ data is stored in the VRAM (See Appendix-1 & 2)

OBJECT DATA AREA SELECT
 : The upper 4K-word out of the area (8K-word) designated by "Object Base Address" is assigned as the Base Area. and the area of the lower 4K-word combined with its Base Area can be selected. (See Appendix-1 & 2)

OBJECT SIZE : DESIGNATE OBJECT SIZE (See Appendix-3 & 4)

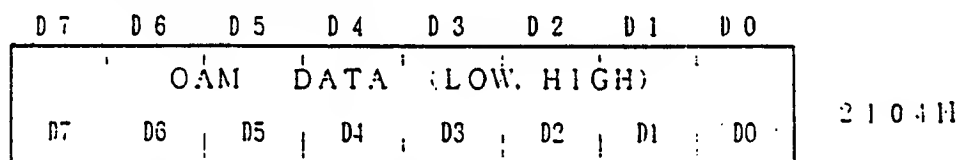
S2	S1	S0	OBJ SIZE		(SIZE LARGE/SMALL)
			0	1	
0	0	0	8 DOT	16 DOT	
0	0	1	8 DOT	32 DOT	
0	1	0	8 DOT	64 DOT	
0	1	1	16 DOT	32 DOT	
1	0	0	16 DOT	64 DOT	
1	0	1	32 DOT	64 DOT	

ADDRESS : 2102H / 2103H
 NAME : OAMADDL / OAMADDH
 CONTENTS : ADDRESS FOR ACCESSING OAM (OBJECT ATTRIBUTE MEMORY)



- This is the INITIAL ADDRESS to be set in advance when reading from the OAM or writing to the OAM.
- By writing "1" to D7 (OAM Priority Rotation) of register <2103H> and setting the OAM address, the OBJ for the address set has highest priority.
- The address which has been set just before every field (beginning of V-BLANK) will be set again to registers <2102H> <2103H> automatically.
But, the address can not be set automatically during Forced Blank period.

ADDRESS : 2104H
 NAME : OAM DATA
 CONTENTS : DATA FOR OAM WRITE



- This is the OAM data to be written at any address of the OAM. See Appendix-3
- After register <2102H> or <2103H> is accessed, the data must be written in the order of Lower 8-Bit & Upper 8-Bit of register <2104H>. The OAM address will be increased automatically when the OAM data is written in the order of LOW & HIGH.
- The data can be written only during V-BLANK or FORCED BLANK period.

ADDRESS : 2105H
 NAME : BGMODE
 CONTENTS : BG MODE & CHARACTER SIZE SETTINGS

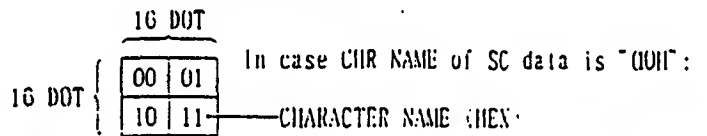
D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
BG SIZE				BG 3	BG MODE		
BG 4	BG 3	BG 2	BG 1	PRIO.	M2	M1	M0

2 1 0 5 H

— BG SCREEN MODE SELECT : See BG Screen Mode Summary (See Appendix-5)

— HIGHEST PRIORITY DESIGNATION FOR BG-3 : Make BG3 highest priority
 [0 : OFF (See Appendix-16)
 [1 : ON

— BG SIZE DESIGNATION : Designate the size for each BG Character (See Appendix-18 & 19)
 [0 : 8 x 8 DOT/CHARACTER
 [1 : 16 x 16 DOT/CHARACTER



ADDRESS : 2106H
 NAME : MOSAIC
 CONTENTS : SIZE & SCREEN DESIGNATION FOR MOSAIC DISPLAY

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
MOSAIC SIZE				MOSAIC ENABLE			
M3	M2	M1	M0	BG 4	BG 3	BG 2	BG 1

2 1 0 6 H

— MOSAIC MODE SELECT : ON/OFF for Mosaic Mode of each BG
 [0 : OFF
 [1 : ON

— MOSAIC MODE SIZE DESIGNATION : DESIGNATE MOSAIC MODE SIZE (SEE APPENDIX-6)

2 5 6 MODE

M3	M2	M1	M0	SIZE
0	0	0	0	1 x 1 DOT
0	0	0	1	2 x 2 DOT
0	0	1	0	3 x 3 DOT
				⋮
1	1	1	0	15x15 DOT
1	1	1	1	16x16 DOT

5 1 2 MODE H x V

M3	M2	M1	M0	SIZE (NON-INTERLACE)
0	0	0	0	2 x 2 DOT (2 x 1 DOT)
0	0	0	1	4 x 4 DOT (4 x 2 DOT)
0	0	1	0	6 x 6 DOT (6 x 3 DOT)
				⋮
1	1	1	0	30x30 DOT (30x15 DOT)
1	1	1	1	32x32 DOT (32x16 DOT)

ADDRESS : 2107H / 2108H / 2109H / 210AH

NAME : BG1SC / BG2SC / BG3SC / BG4SC

CONTENTS : ADDRESS FOR STORING SC-DATA OF EACH BG & SC SIZE DESIGNATION (MODE 0 ~3)

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0																	
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%; text-align:center;">BG 1</td> <td style="width:15%; text-align:center;">SC</td> <td colspan="4" style="text-align:center;">BASE ADDRESS</td> <td style="width:15%; text-align:center;">BG1</td> <td style="width:15%; text-align:center;">SC SIZE</td> </tr> <tr> <td style="text-align:center;">A5</td> <td style="text-align:center;">A4</td> <td style="text-align:center;">A3</td> <td style="text-align:center;">A2</td> <td style="text-align:center;">A1</td> <td style="text-align:center;">A0</td> <td style="text-align:center;">S1</td> <td style="text-align:center;">S0</td> </tr> </table>								BG 1	SC	BASE ADDRESS				BG1	SC SIZE	A5	A4	A3	A2	A1	A0	S1	S0	2107H
BG 1	SC	BASE ADDRESS				BG1	SC SIZE																	
A5	A4	A3	A2	A1	A0	S1	S0																	
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%; text-align:center;">BG 2</td> <td style="width:15%; text-align:center;">SC</td> <td colspan="4" style="text-align:center;">BASE ADDRESS</td> <td style="width:15%; text-align:center;">BG2</td> <td style="width:15%; text-align:center;">SC SIZE</td> </tr> <tr> <td style="text-align:center;">A5</td> <td style="text-align:center;">A4</td> <td style="text-align:center;">A3</td> <td style="text-align:center;">A2</td> <td style="text-align:center;">A1</td> <td style="text-align:center;">A0</td> <td style="text-align:center;">S1</td> <td style="text-align:center;">S0</td> </tr> </table>								BG 2	SC	BASE ADDRESS				BG2	SC SIZE	A5	A4	A3	A2	A1	A0	S1	S0	2108H
BG 2	SC	BASE ADDRESS				BG2	SC SIZE																	
A5	A4	A3	A2	A1	A0	S1	S0																	
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%; text-align:center;">BG 3</td> <td style="width:15%; text-align:center;">SC</td> <td colspan="4" style="text-align:center;">BASE ADDRESS</td> <td style="width:15%; text-align:center;">BG3</td> <td style="width:15%; text-align:center;">SC SIZE</td> </tr> <tr> <td style="text-align:center;">A5</td> <td style="text-align:center;">A4</td> <td style="text-align:center;">A3</td> <td style="text-align:center;">A2</td> <td style="text-align:center;">A1</td> <td style="text-align:center;">A0</td> <td style="text-align:center;">S1</td> <td style="text-align:center;">S0</td> </tr> </table>								BG 3	SC	BASE ADDRESS				BG3	SC SIZE	A5	A4	A3	A2	A1	A0	S1	S0	2109H
BG 3	SC	BASE ADDRESS				BG3	SC SIZE																	
A5	A4	A3	A2	A1	A0	S1	S0																	
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%; text-align:center;">BG 4</td> <td style="width:15%; text-align:center;">SC</td> <td colspan="4" style="text-align:center;">BASE ADDRESS</td> <td style="width:15%; text-align:center;">BG4</td> <td style="width:15%; text-align:center;">SC SIZE</td> </tr> <tr> <td style="text-align:center;">A5</td> <td style="text-align:center;">A4</td> <td style="text-align:center;">A3</td> <td style="text-align:center;">A2</td> <td style="text-align:center;">A1</td> <td style="text-align:center;">A0</td> <td style="text-align:center;">S1</td> <td style="text-align:center;">S0</td> </tr> </table>								BG 4	SC	BASE ADDRESS				BG4	SC SIZE	A5	A4	A3	A2	A1	A0	S1	S0	210AH
BG 4	SC	BASE ADDRESS				BG4	SC SIZE																	
A5	A4	A3	A2	A1	A0	S1	S0																	

SCREEN SIZE DESIGNATION (See Appendix-18 & 19)

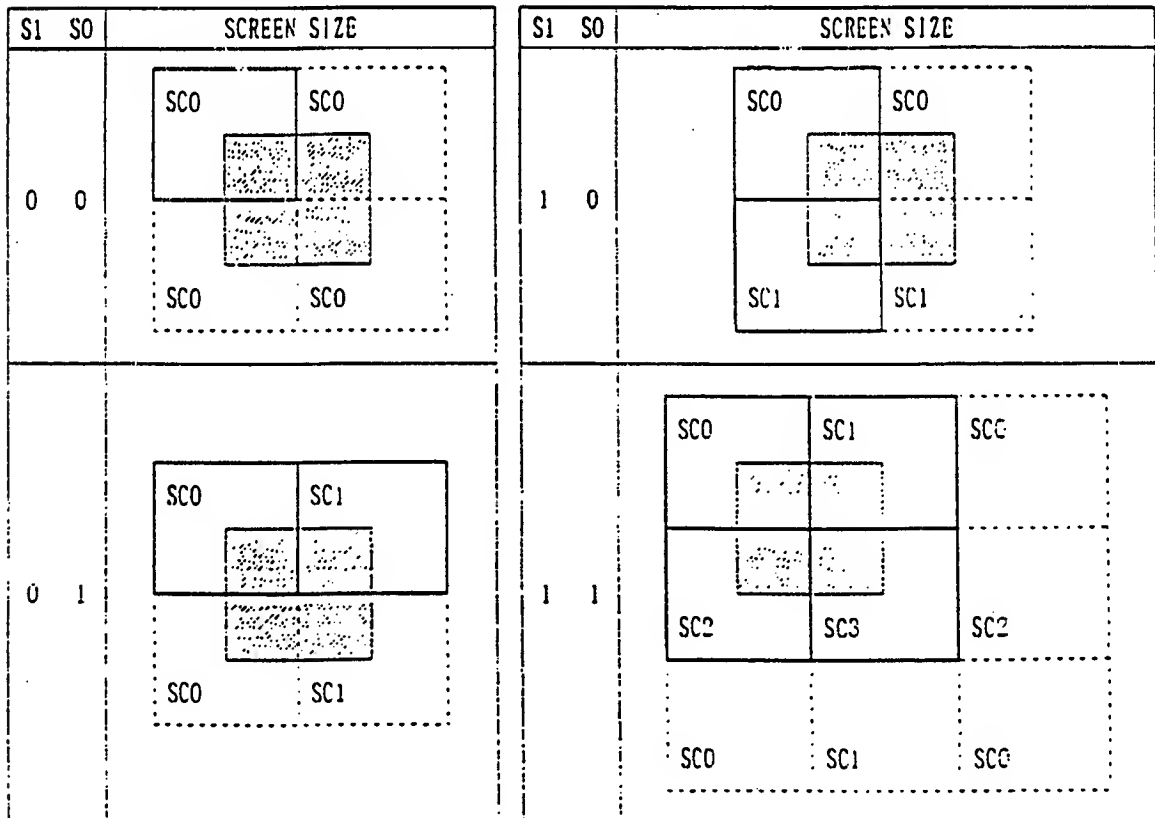
: Designate Background Screen Size

BACKGROUND SCREEN BASE ADDRESS (UPPER 6-BIT)

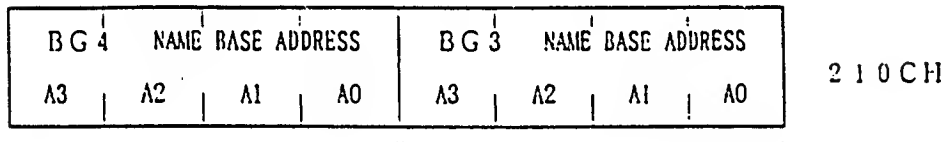
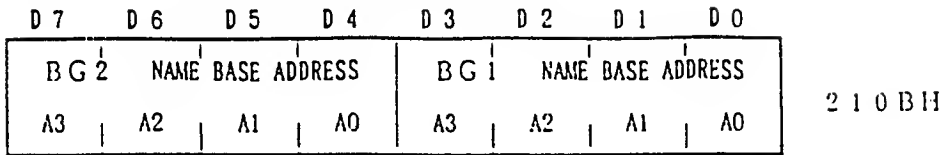
: Designate the segment which BG-SC data in the VRAM is stored.

(1K-WORD SEGMENT)

SCREEN SIZE & SCREEN REPETITION



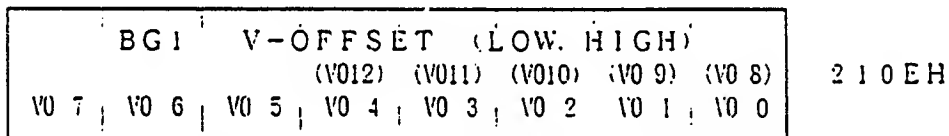
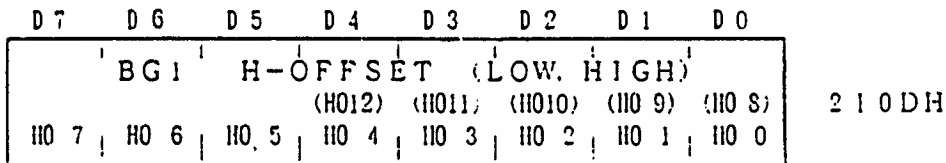
ADDRESS : 210BH / 210CH
 NAME : BG12NBA / BG34NBA
 CONTENTS : BG CHARACTER DATA AREA DESIGNATION



BACKGROUND NAME BASE ADDRESS (UPPER 4-BIT)

: Designate the segment address in the VRAM which BG character data is stored.
 (4K-WORD/SEGMENT)

ADDRESS : 210DH / 210EH
 NAME : BG11H0FS / BG1V0FS
 CONTENTS : H/V SCROLL VALUE DESIGNATION FOR BG-1



- 10-bit maximum (0 ~ 1023) can be designated for H/V scroll value.
 [The size of 13-bit maximum (-4096~4095) can be designated in MODE-7] (See Appendix-S & 9)
- By writing to the register twice, the data can be set in the order of Low and High.

ADDRESS : 210FH / 2110H / 2111H / 2112H / 2113H / 2114H
 NAME : BG2HOFs / BG2VOFs / BG3HOFs / BG3VOFs / BG4HOFs / BG4VOFs
 CONTENTS : H/V SCROLL VALUE DESIGNATION FOR BG-2, 3, 4

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
BG H-OFFSET (LOW, HIGH)								2 1 0 FH
						(H0 9)	(H0 8)	2 1 1 1 H
H0 7	H0 6	H0 5	H0 4	H0 3	H0 2	H0 1	H0 0	2 1 1 3 H
BG V-OFFSET (LOW, HIGH)								2 1 1 0 H
						(V0 9)	(V0 8)	2 1 1 2 H
V0 7	V0 6	V0 5	V0 4	V0 3	V0 2	V0 1	V0 0	2 1 1 4 H

- 10 bit maximum (0~1023) of the H/V scroll value can be designated. (See Appendix-8)
- By writing to the register twice, the data can be set in the order of Low and High.

ADDRESS : 2115H
 NAME : VMAINC
 CONTENTS : VRAM ADDRESS INCREMENT VALUE DESIGNATION

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
H/L					V-RAM ADDRESS SEQUENCE MODE			
INC					FULL GRAPHIC	SC INCREMENT		2 1 0 BH
					G1	G0	I1	I0

Designate the increment value for the VRAM address

(See Appendix-7)

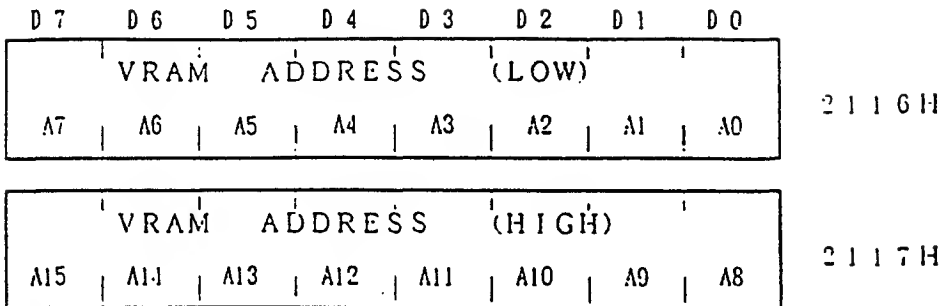
G1	G0	I1	I0	INCREMENT VALUE
0	1	0	0	Increment by 8 for 32 times (2-Bit Formation)
1	0	0	0	Increment by 8 for 64 times (4-Bit Formation)
1	1	0	0	Increment by 8 for 128 times (8-Bit Formation)
0	0	0	0	Address increments 1 BY 1
0	0	0	1	Address increments 32 BY 32
0	0	1	0	Address increments 64 BY 64
0	0	1	1	Address increments 128 BY 128

Designate the increment timing for the address

0 : The address will be increased after the data has been written to register <2118H> or the data has been read from register <2139H>.

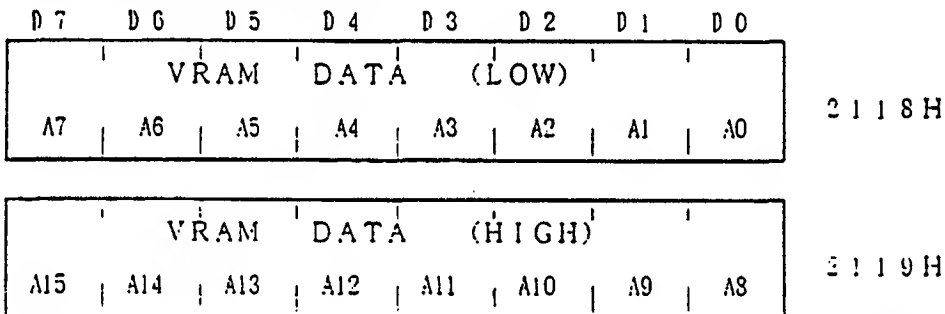
1 : The address will be increased after the data has been written to register <2119H> or the data has been read from register <213AH>.

ADDRESS : 2116H / 2117H
 NAME : VMADDL / VMADDH
 CONTENTS : ADDRESS FOR VRAM READ



- This is the initial address for reading from the VRAM or writing to the VRAM.
- The data is read or written by the address set initially, and every time the data is read, the address will be increased automatically.
- The value to be increased is determined by "SC INCREMENT" of register <2115H> and the setting value of the "FULL GRAPHIC".

ADDRESS : 2118H / 2119H
 NAME : VMADAL / VMADAH
 CONTENTS : DATA FOR VRAM WRITE



- This is the screen data and character data (BG & OBJ), which can write at any address of the VRAM.
- According to the settings of register <2115H> "H/L INC", the data can be written to the VRAM as follows:

H/L INC	WRITE TO REGISTER	OPERATION
0	Write to <2118H> only	The Data is written to lower 8-bit of the VRAM and the address will be increased automatically.
1	Write to <2119H> only	The Data is written to upper 8-bit of the VRAM and the address will be increased automatically.
0	Write in the order of <2119H> & <2118H>	When the data is set in the order of upper & lower the address will be increased.
1	Write in the order of <2118H> & <2119H>	When the data is set in the order of lower & upper the address will be increased.

NOTE : The data can be written only during V-BLANK or FORCED BLANK period.

ADDRESS : 211AH
 NAME : M7SEL
 CONTENTS : INITIAL SETTING IN SCREEN MODE-7

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
SCREEN OVER						SCREEN FLIP	
01 00						V 1 H	

2 1 1 A H

HORIZONTAL/VERTICAL FLIP
 : H-FLIP/V-FLIP in the Screen Mode-7

V	H	DISPLAY
0	0	Normal display
0	1	H-Directional Flip only
1	0	V-Directional Flip only
1	1	Both H & V Directional Flip

The following process is made if the screen to be displayed is outside of the screen area.

01	00	PROCESS OUT OF AREA
0	0	Screen repetition if outside of screen area
1	0	Character # repetition if outside of screen area
1	1	Outside of the screen area is the Back Drop Screen in single color

ADDRESS : 211B H / 211C H / 211D H / 211E H / 211F H / 2120 H
 NAME : M7A / M7B / M7C / M7D / M7X / M7Y
 CONTENTS : ROTATION/ENLARGEMENT/REDUCTION IN MODE-7. CENTER COORDINATE SETTINGS &
 MULTIPLICAND/MULTIPLIER SETTINGS OF COMPLEMENTARY MULTIPLICATION

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
MATRIX PARAMETER A (LOW, HIGH)								211BH
(MP15)	(MP14)	(MP13)	(MP12)	(MP11)	(MP10)	(MP 9)	(MP 8)	
MP 7 , MP 6 , MP 5 , MP 4 , MP 3 , MP 2 , MP 1 , MP 0								
MATRIX PARAMETER B (LOW, HIGH)								211CH
(MP15)	(MP14)	(MP13)	(MP12)	(MP11)	(MP10)	(MP 9)	(MP 8)	
MP 7 , MP 6 , MP 5 , MP 4 , MP 3 , MP 2 , MP 1 , MP 0								
MATRIX PARAMETER C (LOW, HIGH)								211DH
(MP15)	(MP14)	(MP13)	(MP12)	(MP11)	(MP10)	(MP 9)	(MP 8)	
MP 7 , MP 6 , MP 5 , MP 4 , MP 3 , MP 2 , MP 1 , MP 0								
MATRIX PARAMETER D (LOW, HIGH)								211EH
(MP15)	(MP14)	(MP13)	(MP12)	(MP11)	(MP10)	(MP 9)	(MP 8)	
MP 7 , MP 6 , MP 5 , MP 4 , MP 3 , MP 2 , MP 1 , MP 0								

- The 8-bit data should be written twice in the order of lower and upper. Then, the parameter of rotation, enlargement and reduction should be set by its 16-bit data.
- The value down to a decimal point should be set to the lower 8-bit. The most significant bit of the upper 8-bit is for the signed bit. (MP15 is the signed bit. There is a decimal point between M7 & M8)
- FORMULA FOR ROTATION/ENLARGEMENT/REDUCTION (See Appendix-13)

$$\begin{pmatrix} X_2 \\ Y_2 \end{pmatrix} = \begin{pmatrix} A & B \\ C & D \end{pmatrix} \begin{pmatrix} X_1 - X_0 \\ Y_1 - Y_0 \end{pmatrix} + \begin{pmatrix} X_0 \\ Y_0 \end{pmatrix}$$

A = cos γ \times (1/ α), B = sin γ \times (1/ α), C = -sin γ \times (1/ β), D = cos γ \times (1/ β)

γ : Rotation Angle α : Reduction Rates for X(U) β : Reduction Rates for Y(V)

X_0 · Y_0 : Center Coordinate. X_1 · Y_1 : Display Coordinate.

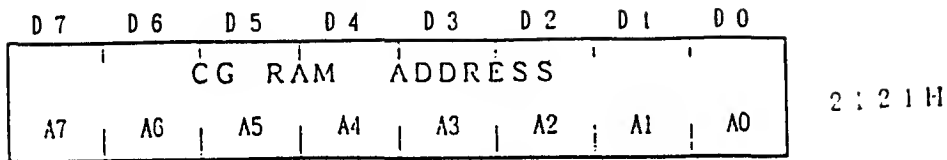
X_2 · Y_2 : Coordinate before Calculation

- Set the value of "A" to the register <211BH>. In the same way, set "B~D" to the register <211CH> ~<211EH>.
- * The complementary multiplication (16-bit \times 8-bit) can be done by using registers <211BH> ~<211EH>. When setting 16-bit data to register <211BH> and 8-bit data to register <211CH>, the multiplication result can be indicated rapidly by reading registers <2134H> ~<2136H>.

d 7	d 6	d 5	d 4	d 3	d 2	d 1	d 0	
CENTER POSITION X_0 (LOW, HIGH)								211FH
		(X12)	(X11)	(X10)	(X9)	(X8)		
X7	X6	X5	X4	X3	X2	X1	X0	
CENTER POSITION Y_0 (LOW, HIGH)								2120H
		(Y12)	(Y11)	(Y10)	(Y9)	(Y8)		
Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	

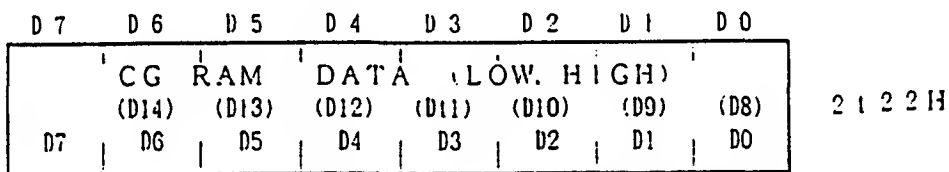
- The center coordinate (X_0 · Y_0) for Rotation/Enlargement/Reduction can be designated by this register.
- The coordinate value of X_0 & Y_0 can be designated by 13-bit (complement of 2).
- This register requires that the lower 8-bit is set first and the upper 8-bit is set. Therefore, 13-bit data in total can be set.

ADDRESS : 2121H
 NAME : CGADD
 CONTENTS : ADDRESS FOR CG-RAM WRITE



- This is the initial address for reading from the CG-RAM or writing to the CG-RAM
- The data is read by the address set initially, and every time the data is read or written, the address will be increased automatically.

ADDRESS : 2122H
 NAME : CGDATA
 CONTENTS : DATA FOR CG-RAM WRITE



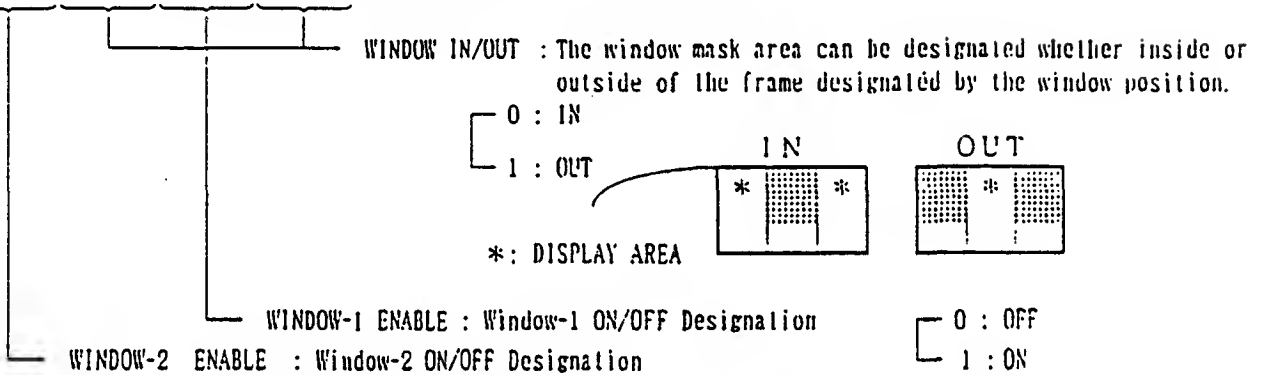
- This is the color generator data to be written at any address of the CG-RAM
- The mapping of BG1~BG4 and OBJ data in the CG-RAM will be determined, which is performed by every mode selected by "BG MODE" of register <2105H>. (See Appendix-14)
- There are the color data of 8-palettes for each screen of BG1 ~ BG4. The palette selection is determined by 3-bit of the SC data "COLOR".
- Because the CG-RAM data is 15-bit/word, it is necessary to set lower 8-bit first to this register and then upper 7-bit should be set. When both lower and upper are set, the address will be increased by 1 automatically.

NOTE : After the address is set, the data should be written from the lower as well as the OAM.

NOTE : The data can be written only during H/V BLANK or FORCED BLANK period.

ADDRESS : 2123H / 2124H / 2125H
 NAME : W12SEL / W34SEL / WOBJSEL
 CONTENTS : WINDOW MASK SETTINGS (BG1~ BG4, OBJ, COLOR)

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
BG 2 WINDOW				BG 1 WINDOW				2 1 2 3 H
W2 EN	IN/OUT	W1 EN	IN/OUT	W2 EN	IN/OUT	W1 EN	IN/OUT	
BG 4 WINDOW				BG 3 WINDOW				2 1 2 4 H
W2 EN	IN/OUT	W1 EN	IN/OUT	W2 EN	IN/OUT	W1 EN	IN/OUT	
COLOR WINDOW				OBJ WINDOW				2 1 2 5 H
W2 EN	IN/OUT	W1 EN	IN/OUT	W2 EN	IN/OUT	W1 EN	IN/OUT	



The COLOR WINDOW is a window for main and sub screen. (It is related to the register <2130H>)

ADDRESS : 2126H / 2127H / 2128H / 2129H
 NAME : W10 / W11 / W12 / W13
 CONTENTS : WINDOW POSITION DESIGNATION (SEE APPENDIX-15)

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
WINDOW				POSITION				2 1 2 6 H WINDOW-1 LEFT POSITION
H0/H1/H2/H3				DESIGNATION				2 1 2 7 H
P7	P6	P5	P4	P3	P2	P1	P0	2 1 2 8 H
								2 1 2 9 H

WINDOW H0 POSITION <2126H> : Window-1 Left Position Designation. It can be set in range of 0 ~ 255.
 WINDOW H1 POSITION <2127H> : Window-1 Right Position Designation. It can be set in range of 0 ~ 255.
 WINDOW H2 POSITION <2128H> : Window-2 Left Position Designation. It can be set in range of 0 ~ 255.
 WINDOW H3 POSITION <2129H> : Window-2 Right Position Designation. It can be set in range of 0 ~ 255.

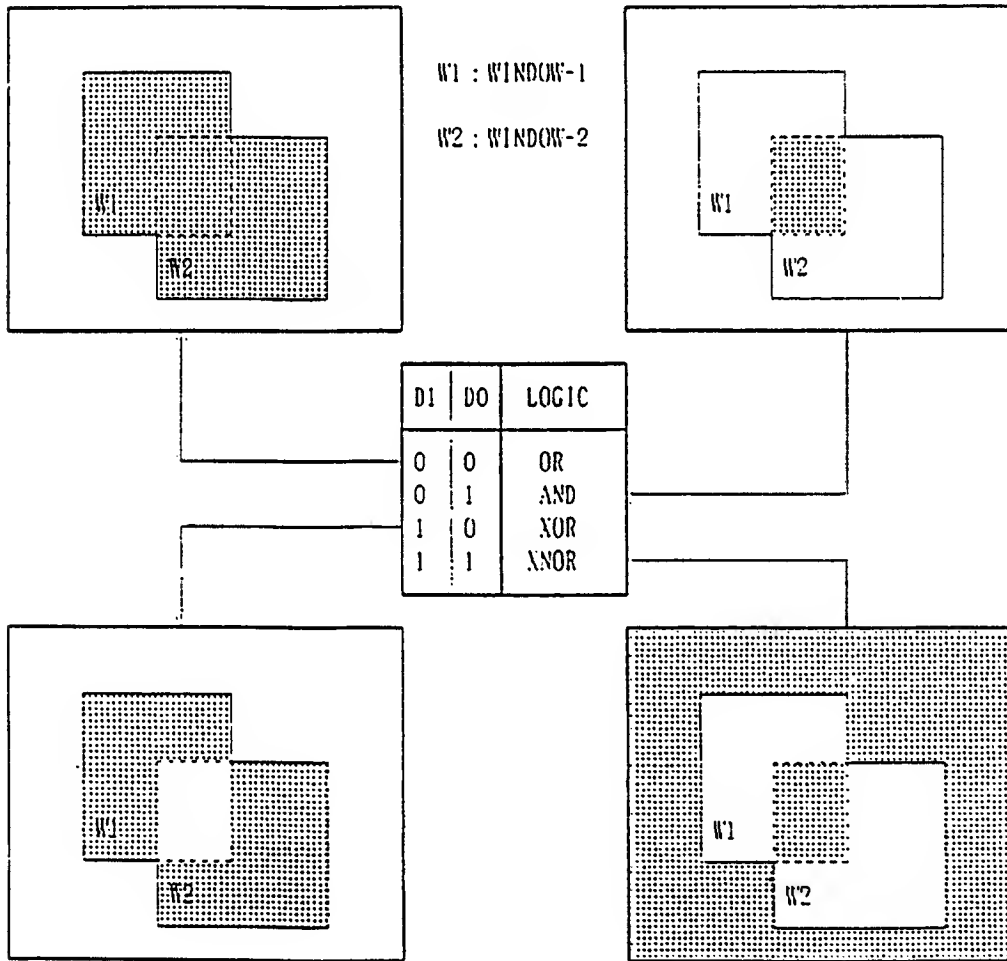
NOTE : If "LEFT POSITION SETTING VALUE > RIGHT POSITION SETTING VALUE" is assumed, there will be no range of the window.

ADDRESS : 212AH / 212BH
 NAME : WBGLOG / WOBJLOG
 CONTENTS : MASK LOGIC SETTINGS FOR WINDOW-1 & 2 ON EACH SCREEN
 D 7 D 6 D 5 D 4 D 3 D 2 D 1 D 0

WINDOW LOGIC								212AH
BG 4		BG 3		BG 2		BG 1		
D1	D0	D1	D0	D1	D0	D1	D0	
WINDOW LOGIC				WINDOW LOGIC				212BH
Color				OBJ				
D1	D0	D1	D0	D1	D0	D1	D0	

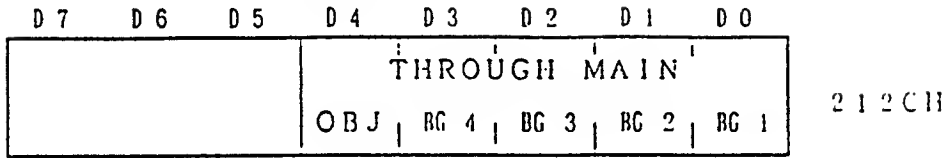
WINDOW LOGIC : SET MASK LOGIC FOR WINDOW-1 & 2

When both window-1 and window-2 are "IN", the shaded portion will be masked as follows:



NOTE : "IN/OUT" of registers <2123H> <2124H> <2125H> becomes the "NOT logic" for each window-1 and window-2.

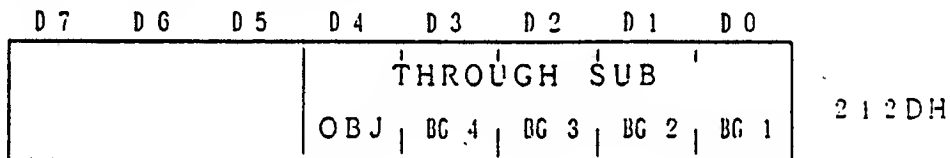
ADDRESS : 212CH
 NAME : TM
 CONTENTS : MAIN SCREEN DESIGNATION



MAIN SCREEN DESIGNATION
 : Designate the screen (BG1 ~ BG4, OBJ) to be displayed as the Main Screen.
 Designate the screen to be added for the screen, addition/subtraction

0 : DISABLE
 1 : ENABLE

ADDRESS : 212DH
 NAME : TS
 CONTENTS : SUB SCREEN DESIGNATION

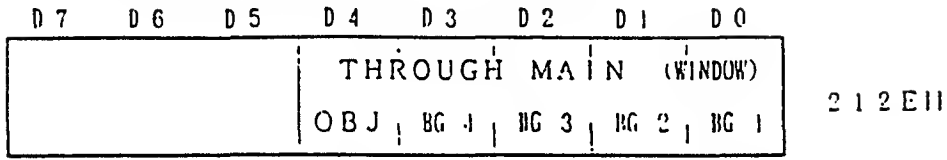


SUB SCREEN DESIGNATION
 : Designate the screen (BG1 ~ BG4, OBJ) to be displayed as SUB-Screen.
 Designate the addition subtraction screen at the point when the screen addition/subtraction is functioning.

0 : DISABLE
 1 : ENABLE

※ When the screen addition/subtraction is functioning, the SUB screen is a screen to be added or subtracted against the MAIN screen.

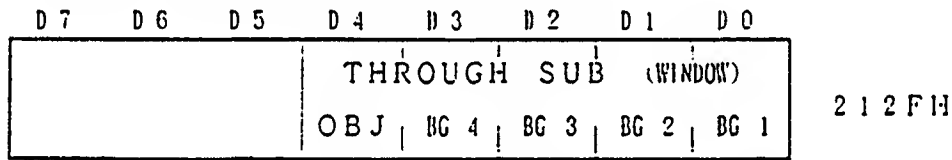
ADDRESS : 212E11
 NAME : TMM
 CONTENTS : WINDOW MASK DESIGNATION FOR MAIN SCREEN



WINDOW MASK DESIGNATION FOR MAIN SCREEN
 : In the window area designated by register
 <212311> ~ <212911>, the screen to be displayed can be
 designated, which is selected among the Main screen
 designated by register <212C11>.

0 : DISABLE
 1 : ENABLE

ADDRESS : 212F11
 NAME : TSW
 CONTENTS : WINDOW MASK DESIGNATION FOR SUB SCREEN



WINDOW MASK DESIGNATION FOR SUB SCREEN
 : In the window area designated by register
 <212311> ~ <212911>, the screen to be displayed can be
 designated, which is selected among the Sub screen
 designated by register <212C11>.

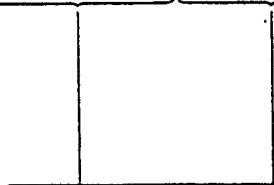
0 : DISABLE
 1 : ENABLE

※ When the screen addition subtraction is functioning, the SUB screen is a screen
 to be added or subtracted against the MAIN screen.

ADDRESS : 2130H
 NAME : CGSWSEL
 CONTENTS : INITIAL SETTINGS FOR FIXED COLOR ADDITION OR SCREEN ADDITION

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
COLOR WINDOW ON/OFF				CC ADD		DIRECT	
MAIN SW (A)		SUB SW (B)					
M1	NO	S1	SO	ENABLE		SELECT	

2 1 3 0 H



COLOR WINDOW ON/OFF MAIN/SUB SWITCH
 : When the Color Window is functioning, the assignment of the window area for MAIN and SUB screen can be designated.

DIRECT SELECT (See Appendix-14)
 : The VRAM data (Color and Character data) become the color data directly. (Only when mode-3, 4 & 7 are selected)
 [0 : DISABLE
 1 : ENABLE

FIXED COLOR ADDITION/SUBTRACTION ENABLE
 : Designate whether 2 kinds of the data should be added/subtracted each other or not, which are the fixed color set by register <2132H> and the color data which is set to the CGRAM.
 [0 : ADDITION/SUBTRACTION FOR FIXED COLOR
 1 : ADDITION/SUBTRACTION FOR SUB SCREEN

M1(S1)	MO(SO)	FUNCTION
0	0	ON (All the time)
0	1	ON (inside window only)
1	0	ON (outside window only)
1	1	OFF (All the time)

ADDRESS : 2131H
 NAME : CGADSUB
 CONTENTS : ADDITION/SUBTRACTION & SUBTRACTION DESIGNATION FOR EACH SCREEN, OBJ & BACKGROUND COLOR

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
ADD	1/2	ADD or SUB ENABLE					
SUB	ENABLE	BACK	OBJ	BG 4	BG 3	BG 2	BG 1

2 1 3 1 H

COLOR DATA ADDITION/SUBTRACTION ENABLE
 : Designate the selection either of the disable or the enable for the addition/subtraction of the fixed color data or the screen color data.
 [0 : DISABLE
 1 : ENABLE (Addition/Subtraction function : ON)

NOTE : In case the OBJ is designated, the Addition Subtraction function is available only when the OBJ color palette is either 6 or 7.

"1/2 OF COLOR DATA" DESIGNATION : When the color constant addition/subtraction or the screen addition/subtraction is performed, designate whether the RGB result in the addition/subtraction area should be "1/2" or not. However, in the back (color constant) area on the Sub screen, it does not become "1/2".
 [0 : DISABLE
 1 : ENABLE (1/2 function : ON)

COLOR DATA ADDITION/SUBTRACTION SELECT : Designate the selection either of the addition or the subtraction mode.
 [0 : ADDITION MODE SELECT
 1 : SUBTRACTION MODE SELECT

ADDRESS : 2132H
 NAME : COLDATA
 CONTENTS : FIXED COLOR DATA FOR FIXED COLOR ADDITION/SUBTRACTION

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
COLOR CONSTANT DATA							
COLOR BRILLIANCE DATA							
BLUE	GREEN	RED	D4	D3	D2	D1	D0

2 1 3 2 H

COLOR CONSTANTOR DATA : Set the color constant data for color constant addition/subtraction

COLOR DESIGNATION : BIT FOR SELECTING DESIRED COLOR

- R/G/B brightness should be set by the data of each 5-Bit.
- (EXAMPLE)
- | | | | | |
|-------|---|------|-----|-----------------------|
| RED | : | CON. | 3FH | (B=00H, G=00H, R=1FH) |
| GREEN | : | A0H | 5FH | (D=00H, G=1FH, R=00H) |
| BLUE | : | 00H | 9FH | (B=1FH, G=00H, R=00H) |
| WHITE | : | | FFH | |
| BLACK | : | | E0H | |

ADDRESS : 2133H
 NAME : SETINI
 CONTENTS : SCREEN INITIAL SETTING

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
EXT. SYNC.	EXT. INPUT	PSEUDO 512		224 / 239	OBJ-V SELECT	INTER-LACE	

2 1 3 3 H

SCANNING : INTERLACE/NON-INTERLACE SELECTION

(It relates to <2105H>.)

- 0 : NON-INTERLACE
- 1 : INTERLACE

OBJ V-DIRECTION DISPLAY

: In the interlace mode, select either of 1-dot per line or 1-dot repeated every 2 lines. If "1" is written, the OBJ seems to be reduced half vertically in appearance.

(If "1" is set other than the interlace mode, even-numbered line and odd-numbered line of the OBJ will be displayed alternately every field.)

BG V-DIRECTION DISPLAY : Switch the display line of a field to 224-Line or 239-Line.

(In case of interlace mode, it will be doubled dot.)

- 0 : 224 LINE
- 1 : 239 LINE

HORIZONTAL PSEUDO 512 MODE : 512 imaginary resolution (Horizontal can be made by shifting the SCR screen half dot to the left.

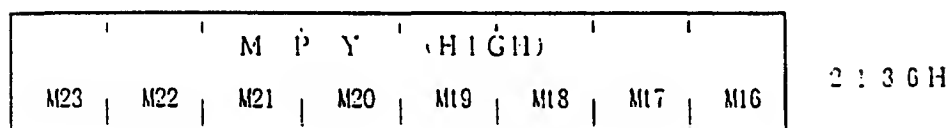
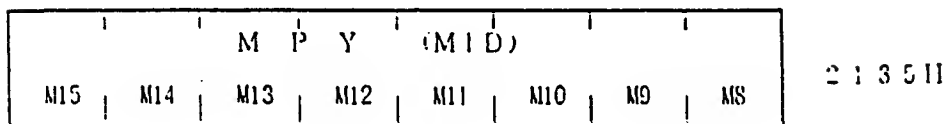
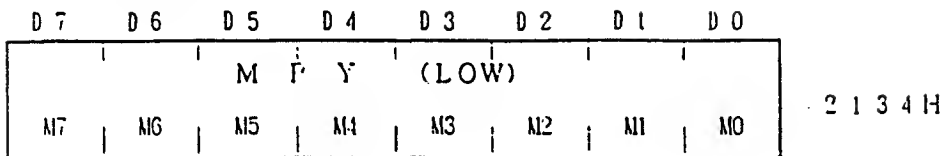
alternately every field : 0 : DISABLE

- 1 : ENABLE

EXTBG MODE (SCREEN EXPAND) : Enable the data supplied from the external LSI. For the SFX, enable when the screen with priority is used on mode-7.

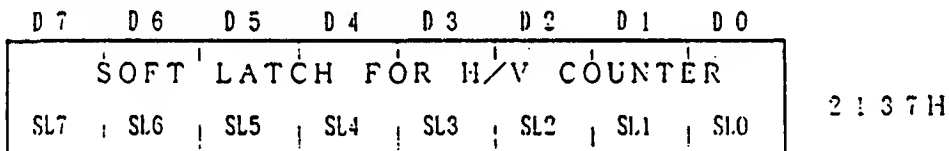
EXTERNAL SYNCHRONIZATION : It is used for super-impose and etc. Normally, "0" should be written.

ADDRESS : 2134H / 2135H / 2136H
 NAME : *MPYL / *MPYM / *MPYH
 CONTENTS : MULTIPLICATION RESULT



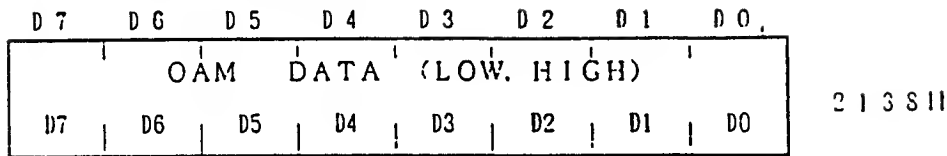
- This is a Multiplication result (complement of 2) can be read by setting 16-bit to register <211BH> and setting 8-Bit data to register <211CH>.

ADDRESS : 2137H
 NAME : *SLIV
 CONTENTS : SOFTWARE LATCH FOR H/V COUNTER



- This is a register, which generate the pulse for latching the H/V counter value.
- The H/V counter value at the point when register <2137H> is read can be latched. The data which was read is meaningless data.
- The H/V counter value latched can be referred by registers <213CH> <213DH>.

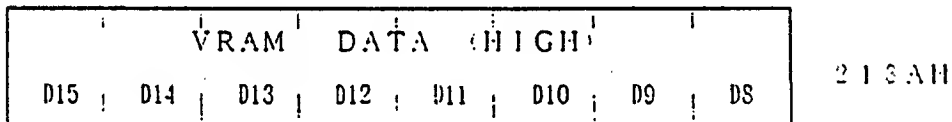
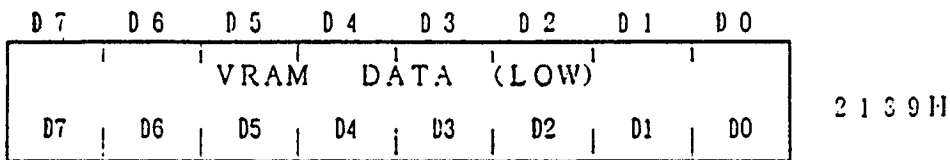
ADDRESS : 2138H
 NAME : *OAMDATA
 CONTENTS : READ DATA FROM OAM



- This is a register, which can read the data at any address of the OAM.
- When the address is set to register <2102H><2103H> and register <2138H> is also accessed, the data can be read in the order of Low 8-bit/High 8-bit. Afterward, the address will be increased automatically, and the data of the next address can be read.

NOTE : The data can be read only during H/V BLANK or FORCED BLANK period.

ADDRESS : 2139H / 213AH
 NAME : *VMIDATA / *VMIDATAH
 CONTENTS : READ DATA FROM VRAM



- This is a register, which can read the data at any address of the VRAM.
- The initial address should be set by registers <2116H> and <2117H>. The data can be read by the address which has been set initially.
- When reading the data continuously, the first data for the address increment should be read as a dummy data after the address has been set.
- Quantity to be increased will be determined by "SC INCREMENT" of register <2115H> and the setting value of the "FULL GRAPHIC"

NOTE : The data can be read only during H/V BLANK or FORCED BLANK period.

ADDRESS : 213BH
 NAME : *CGDATA
 CONTENTS : READ DATA FROM CG-RAM

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
CG DATA (LOW, HIGH)								2 1 3 B H
(D14) (D13) (D12) (D11) (D10) (D9) (D8)								
D7	D6	D5	D4	D3	D2	D1	D0	

- This is a register, which can read the data at any address of the CG-RAM.
- The initial address can be set by register <2121H>. The lower 8-bit is read first, and then the upper 7-bit will be read by accessing this register. The current address will be increased to the next address at the same time the upper 7-bit is read.

NOTE : The data can be read only during H/V BLANK or FORCED BLANK period.

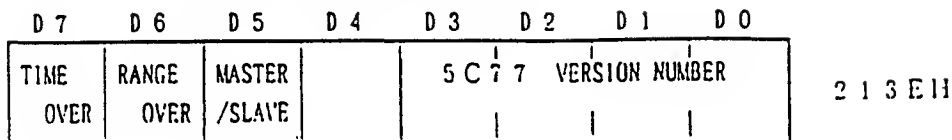
ADDRESS : 213CH / 213DH
 NAME : *OPHCT / *OPVCT
 CONTENTS : H/V COUNTER DATA BY EXTERNAL OR SOFTWARE LATCH

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
OUTPUT DATA OF H-COUNTER								2 1 3 C H
(H8)								
H7	H6	H5	H4	H3	H2	H1	H0	

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
OUTPUT DATA OF V-COUNTER								2 1 3 D H
(V8)								
V7	V6	V5	V4	V3	V2	V1	V0	

- The H/V counter is latched by reading register <2137H>, and its H/V counter value can be read by this register.
- The H/V counter is also latched by the external latch, and its value can be read by this register.
- If register <213CH> or <213DH> is read after register <213FH> has been read, the lower 8-bit data will be read first, and then the upper 1-bit will be read by reading the register.

ADDRESS : 213EH
 NAME : +STAT77
 CONTENTS : PPU STATUS FLAG & VERSION NUMBER



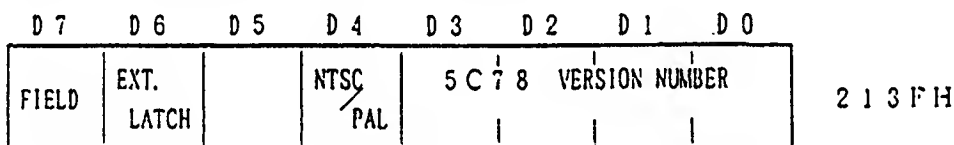
MASTER / SLAVE MODE SELECT : LSI MODE (Normally "0" is set)

OBJ DISPLAY STATUS (ON A HORIZONTAL LINE)

- RANGE : When Quantity of the OBJ (regardless of the size) becomes 33 pcs or more. "1" will be set.
- TIME : When quantity of the OBJ which is converted to "8 X 8-SIZE" is 35 pcs or more. "1" will be set.

NOTE : The flag will be reset at the end of the V-BLANK period.

ADDRESS : 213FH
 NAME : +STAT78
 CONTENTS : PPU STATUS FLAG & VERSION NUMBER



DISPLAY METHOD

- 0 : NTSC
- 1 : PAL

EXTERNAL LATCH FLAG : When the external signal (Light Pen, etc.) is applied, it enables to latch the H/V counter value.

FIELD : This is a status flag, which indicates whether 1st field is scanned or 2nd field is scanned the interlace mode. (The definition is different from the field of NTSC)

- 0 : 1ST FIELD
- 1 : 2ND FIELD

• When this register is read, registers <213CH> <213DH> will be initialized individually in the order of Low and High.

ADDRESS : 2140H / 2141H / 2142H / 2143H
 NAME : APU100 / APU101 / APU102 / APU103
 CONTENTS : COMMUNICATION PORT WITH APU

D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	
								2 1 4 0 H
	A	P	U		I/O		P O R T	2 1 4 1 H
								2 1 4 2 H
								2 1 4 3 H

- This port provides more registers for the purpose of IN/OUT, which are 8 registers in total in the APU. Therefore, the different register will be accessed, whether reading or writing for the same address.
- See APU MANUAL for the details of the communication method

SUPER FAMICOM DOCUMENTATION

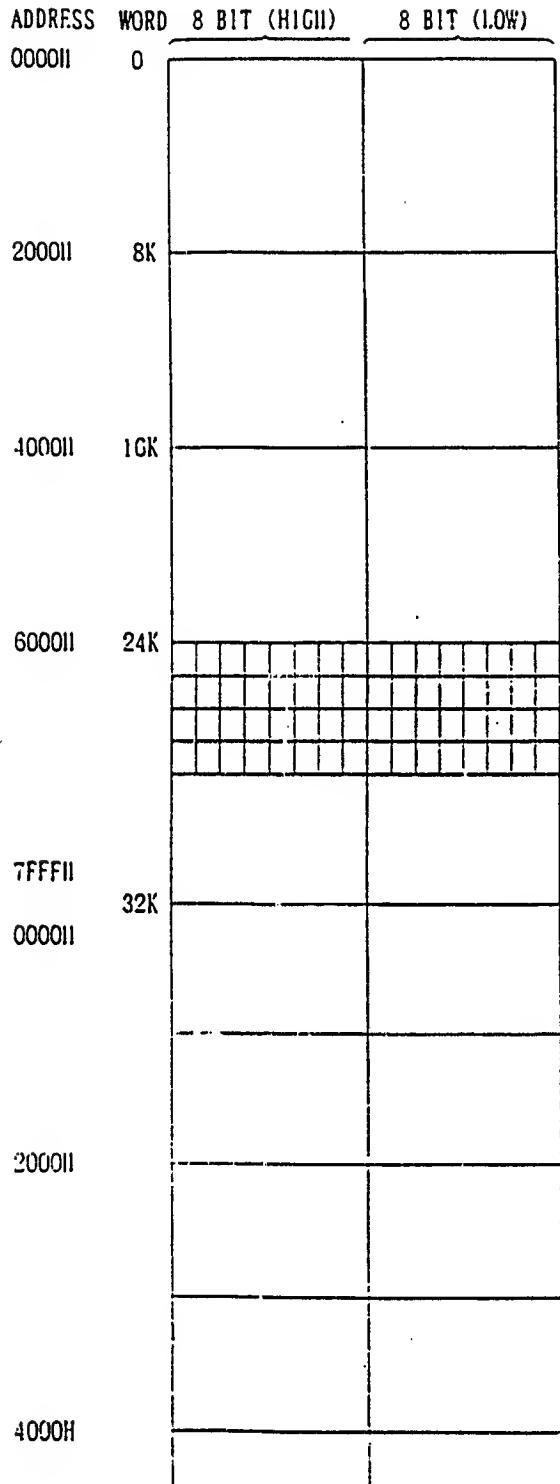
SFX02X

**REGISTER
(PPU)**

APPENDIX



A 1.000.000 BOYS A.K.A MEGABOYS PRODUCE



8K-WORD : This is a area which is designated by "OBJ NAME BASE ADDRESS" of the register <2101H>. (32K-WORD / 4-Partition [The BA2 of the register <2101H> "OBJ NAME BASE ADDRESS" is used for expansion purpose, and it will normally be ignored.]

[In case BA1=1 and BA0=1 are set by "OBJ NAME BASE ADDRESS"

4K-WORD : This is a lower 4K-WORD of the area (8K-WORD) designated by "OBJ NAME BASE ADDRESS" of the register <2101H>.

The combination of this 4K-WORD and the 4K-WORD remaining will be determined by "OBJ NAME BASE SELECT" of the register <2101H>.

- ①
- ②
- ③
- ④

OBJ Name Select

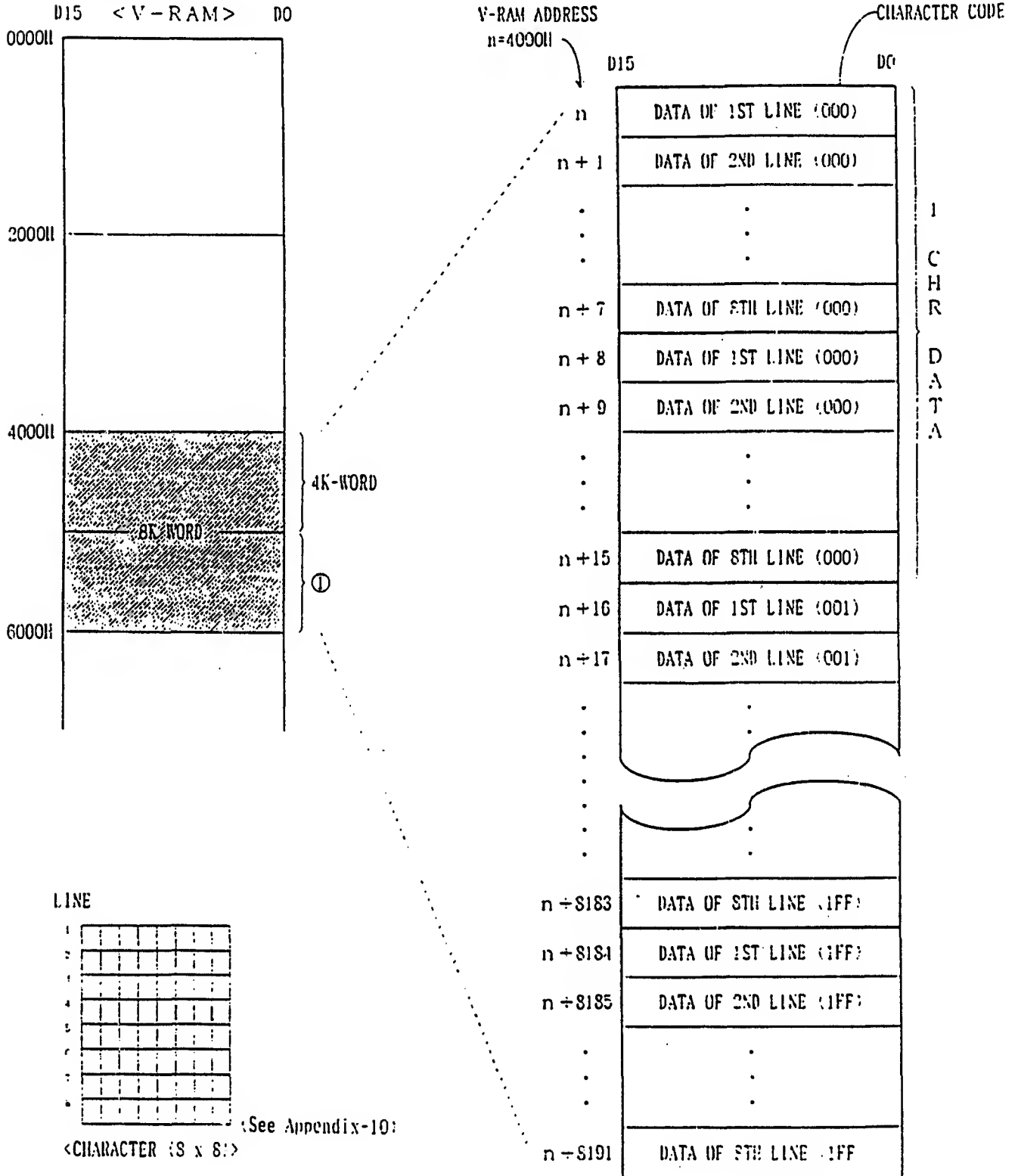
NI	NO	COMBINATION
0	0	4K-WORD - ①
0	1	4K-WORD - ②
1	0	4K-WORD - ③
1	1	4K-WORD - ④

OBJECT DATA TO BE STORED

4 BIT CONSTRUCTION [8 x 8 x 4 Bit (16 WORD)/Character] (See Appendix-10)

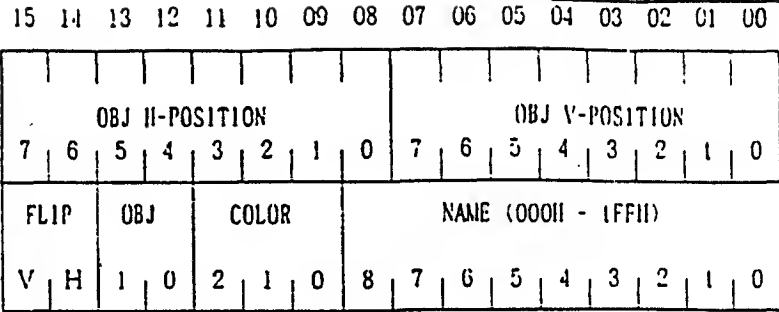
8 x 8 (Character Size) x 4 (Bit Construction) x 512 (Number of character) ——— 16K-BYTE

[In case BA1=1 and BA0=0 are set by "OBJ NAME BASE ADDRESS" and also N1=0 and N0=0 are set by "OBJ NAME SELECT"]



OBJECT DATA
OAM ADDRESS D15 D0

0 0 0	OBJ 0
0 0 1	
0 0 2	OBJ 1
0 0 3	
.	
.	
2 5 2	OBJ 126
5 2 3	
2 5 4	OBJ 127
2 5 5	
2 5 6	OBJ 7 - OBJ 0
	OBJ 15 - OBJ 8
2 7 0	OBJ 119- OBJ 112
2 7 1	OBJ 127- OBJ 120

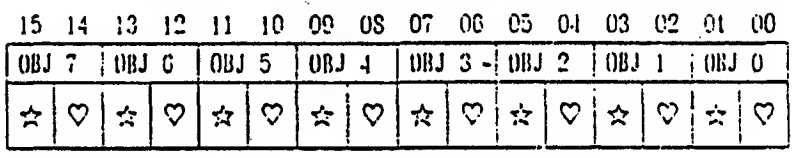


CHARACTER CODE NUMBER
(See Appendix-4)

COLOR PALETTE SELECT
: Designate palette for 1 character

OBJ PRIORITY
: Determine the display priority when OBJ is combined with BG1~BG4 (per character). [See Appendix-16 for Priority]

H/V FLIP
: X-direction Flip(H-Flip), Y-direction (V-Flip)
[The character is flipped, but H/V position does not change.]



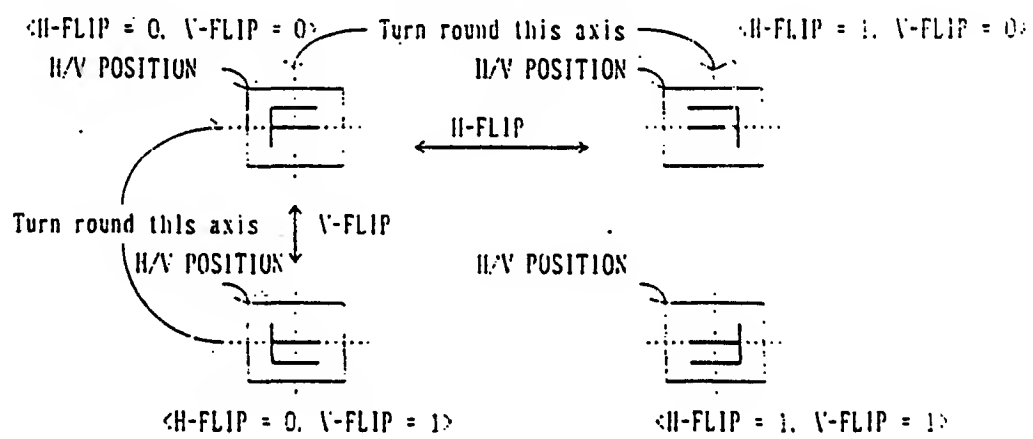
☆ Size large/Small ♡ H-Position MSB

The base position of the OBJ on the H-direction will be determined by both H-position (S-bit) and the H-position MSB.

SIZE LARGE/SMALL: Determine the size to be used either of 2 OBJs selected by the register <210H>.

0 : Select small size
1 : Select large size

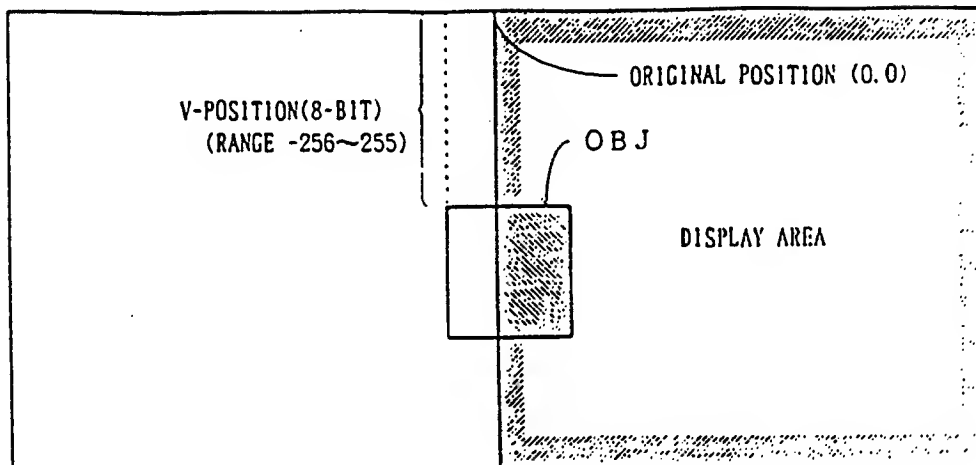
H/V FLIP



OBJECT DISPLAY

H-POSITION(9-BIT)(RANGE-256~255)

APPENDIX-4 (PPU)



H-POSITION

-256 ~ -1 (100H~1FFH)



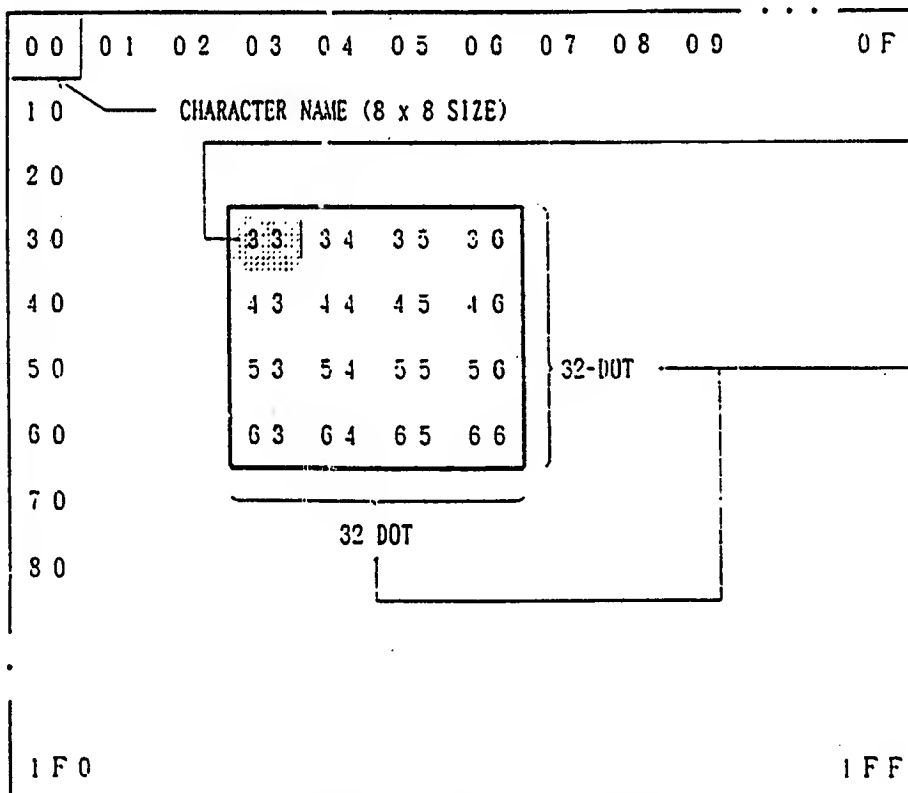
0 ~ 255 (000H~0FFH)

(NOTE-1) The H-position is a complementary expression of 2 (9-bit).

(NOTE-2) The coordinate of the OBJ displayed is shifted down compared to the coordinate of the BG displayed. [Interlace : 2-dot / Non-Interlace : 1-dot] (See Appendix-8)

(NOTE-3) "001H" is basically prohibited to use for 9-bit of the H-Position. (If it is used, it must be counted as OBJ quantity displayed even it is not displayed on the screen.)

OBJECT CHARACTER DATA CONSTRUCTION (V-RAM)



(EXAMPLE)

1 Write 33 to "NAME" by the IAM

2 Write "001" (8 or 32) to "OBJ SIZE SELECT" of the register (2102H)

3 Write "1" (32 x 32) to "SIZE LARGE/SMALL" by the OAM

In case the character code is 000 through 0FF, the V-RAM address per character data (16-word) will be "n(Name Base Address) + N(name) x 16 ~ n + N x 16 + 15". And in case the character code is 100 through 1FF, it will be "n + Ns (Name Select) x 4K + N x 16 ~ n + Ns x 4K + N x 16 + 15".

OBJECT MODE

# OF CELLS DISPLAYED	1 2 8			
CELL SIZE	8 × 8	16 × 16	32 × 32	64 × 64
# OF LINES DISPLAYED	32-pcs (converted to 8x8 size)			
# OF CELL-COLOR	1 6			
# OF PALETTE	8			
# OF COLOR ON SCREEN	1 2 8			
ATTRIBUTE	H-FLIP, V-FLIP FUNCTION DISPLAY PRIORITY (Select priority against BG)			

BG MODE

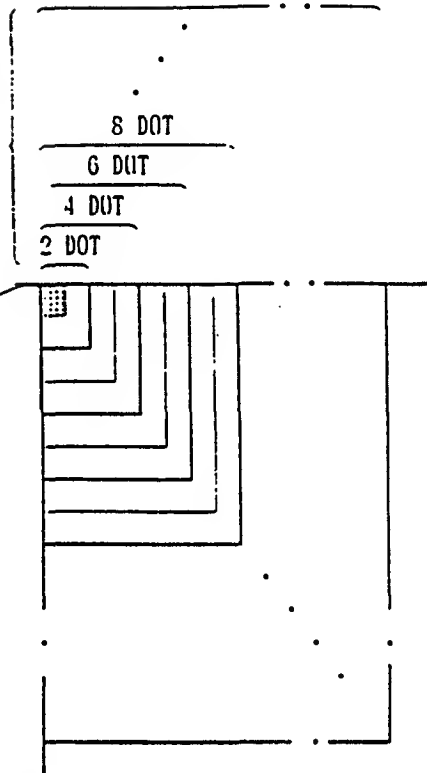
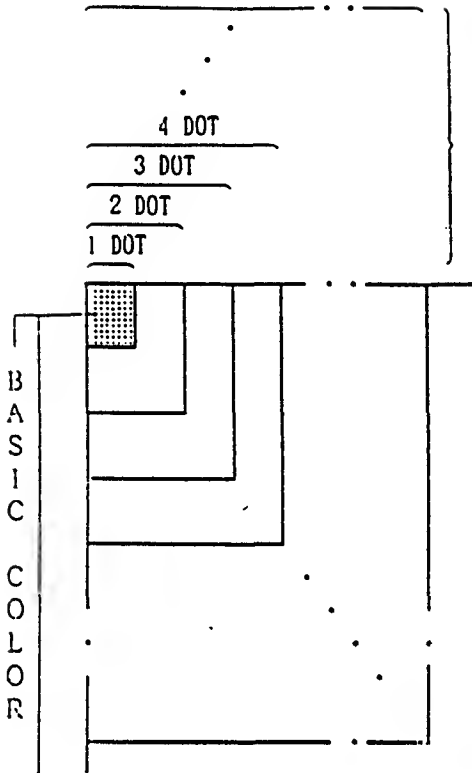
MODE	# OF SCREEN DISPLAYED	SCREEN	# OF CELL DOT	# OF CELL COLOR	# OF PALETTES	# OF COLORS PER SCREEN	FUNCTION
0	MAX 4	BG 1	8 × 8 & 16 × 16	4	8	3 2	H/V SCROLL H-FLIP, V-FLIP WINDOW MOSAIC FIXED-COLOR ADDITION SCREEN COLOR ADDITION ① Offset value can be set in H/V direction against the cell ② H-512 mode vertical expansion caused interlace ③ Enlargement Reduction Rotation ④ ⑤
		BG 2		4	8	3 2	
		BG 3		4	8	3 2	
		BG 4		4	8	3 2	
1	MAX 3	BG 1		16	8	1 2 8	
		BG 2		16	8	1 2 8	
		BG 3		4	8	3 2	
2	MAX 2	BG 1		16	8	1 2 8	
		BG 2		16	8	1 2 8	
3	MAX 2	BG 1		2 5 6	1	2 5 6	
		BG 2		16	8	1 2 8	
4	MAX 2	BG 1		2 5 6	1	2 5 6	
		BG 2		4	8	3 2	
5	MAX 2	BG 1		16	8	1 2 8	
		BG 2		4	8	3 2	
6	1	BG 1		16	8	1 2 8	
7	1	BG 1	8 × 8	2 5 6	1	2 5 6	

MOSAIC SCREEN

In case of H-256
16 DOT

In case of H-512
32 DOT

Designated the size
by "MOSAIC SIZE" of
the register <210GH>

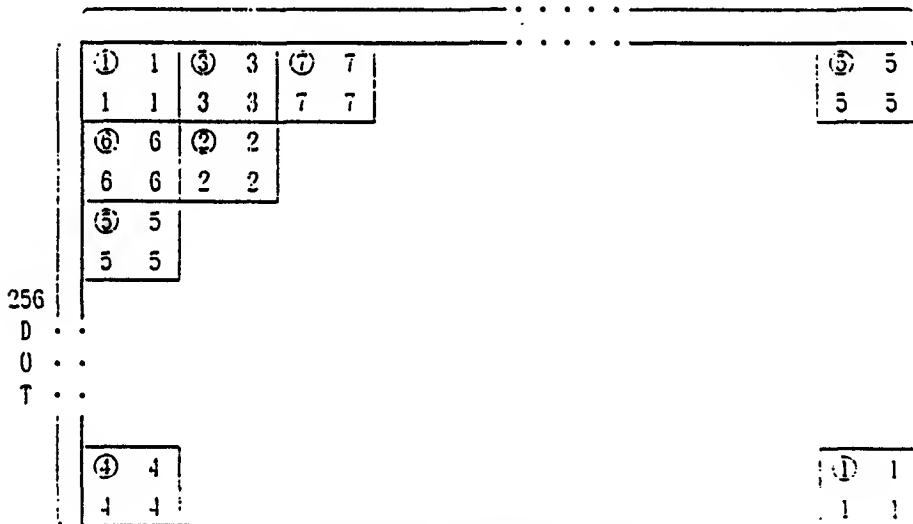


*all dots of the size designated become this color.

In case of the H-Pseudo 512 mode. 2 x 2-dot mosaic
can be made in size-0. (See No. 3)

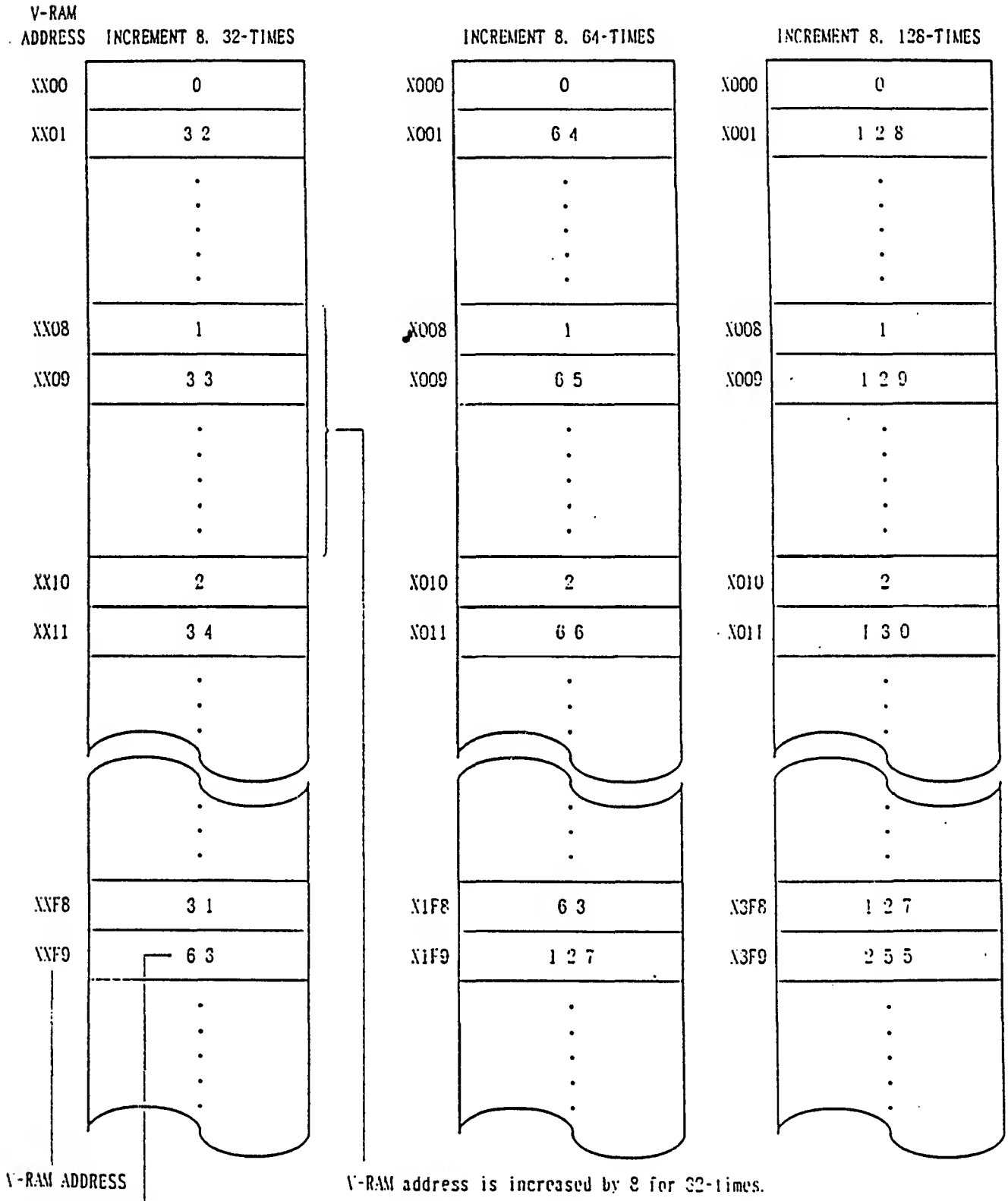
MOSAIC SCREEN DISPLAY EXAMPLE (BG SCREEN) (When the mosaic size is 2x2-dot in the 256-mode)

256 DOT



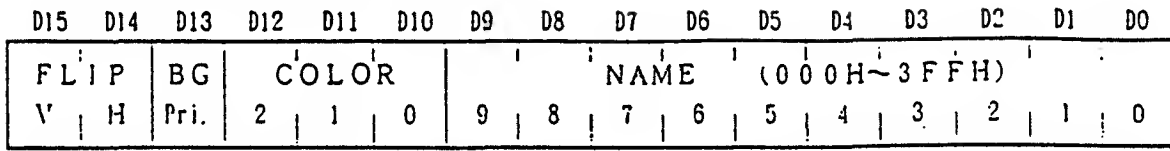
○ is the basic color data

ADDRESS INCREMENT VALUE SET (THE ORDER OF ACCESSING)



ORDER OF ACCESS (corresponding to the address designated by the register #2116H~2117H)

BG SC DATA (MODE 0~6)



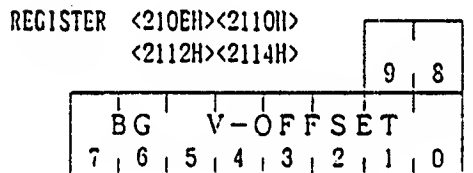
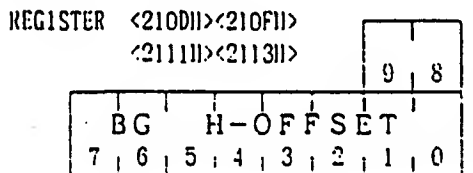
CHARACTER CODE NUMBER

COLOR PALETTE SELECT : PALETTE DESIGNATION PER CHARACTER <8-Palettes>

BG PRIORITY : Determine the display priority per character in case OBJ and BG1 ~BG4 are combined on the same screen.

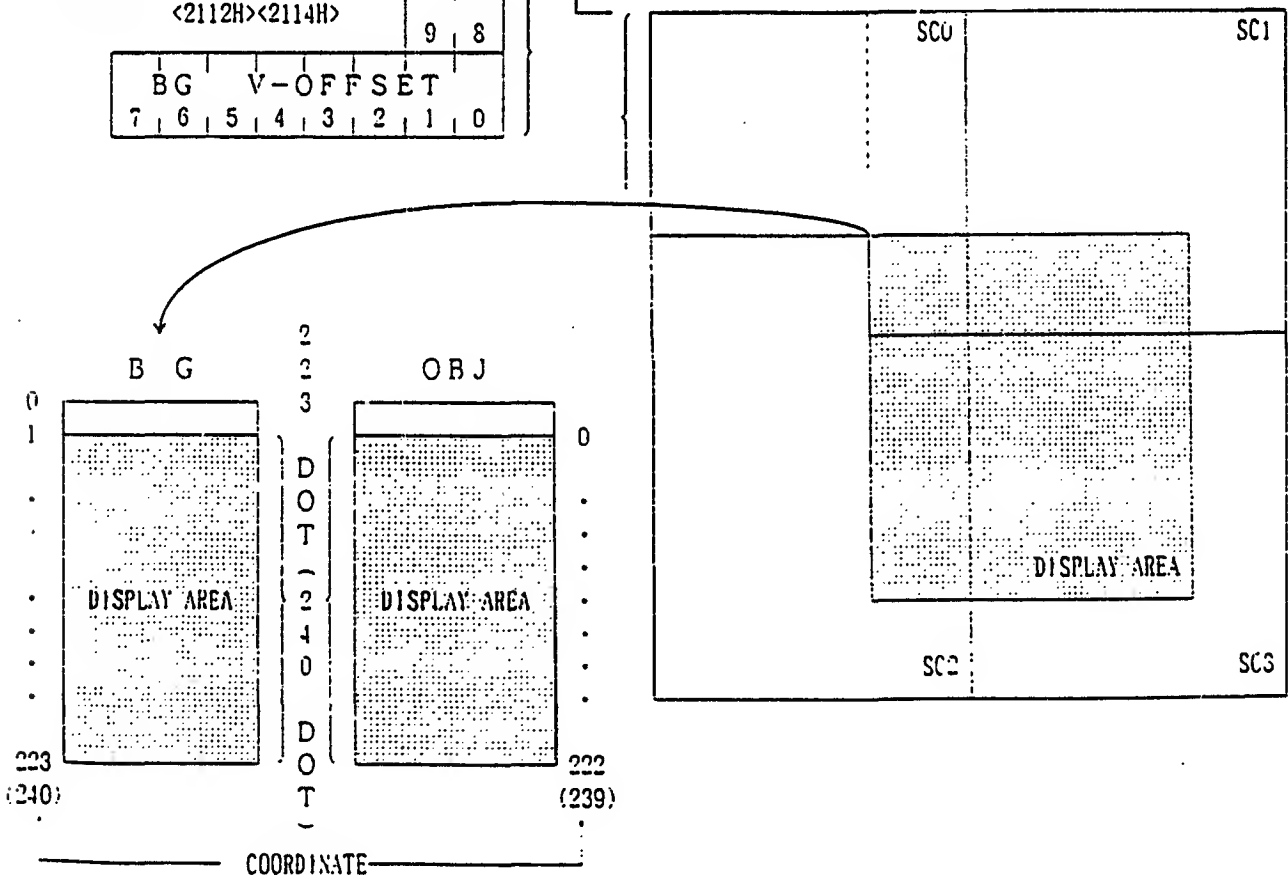
H/V FLIP : X-Directional Flip (H-FLIP), Y-Directional Flip (V-FLIP)

BG SCREEN H/V SCROLL

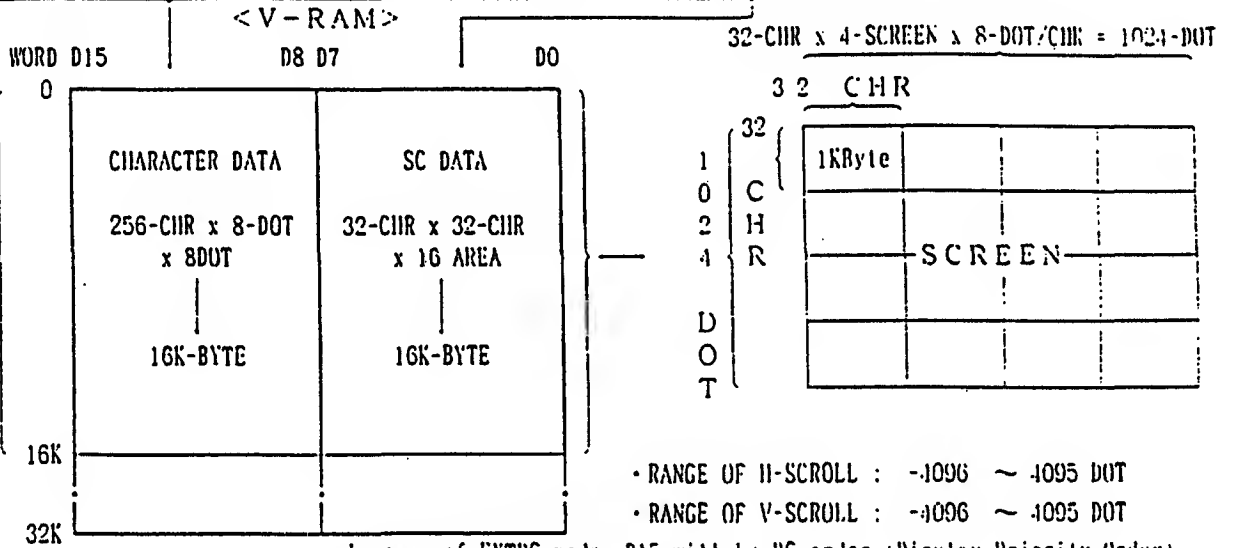
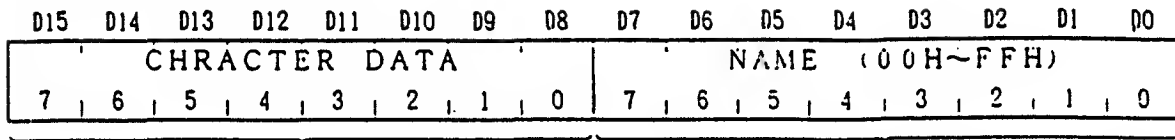


- RANGE OF H-SCROLL
0 ~ 1024 DOT
- RANGE OF V-SCROLL
0 ~ 1024 DOT

H/V scroll range may be changed and 2-dot scroll may be possible, depending on the combination of the modes (512, 1G-size, interlace etc.). Also, SC size may be changed against the screen. (See Appendix-18 & 19)

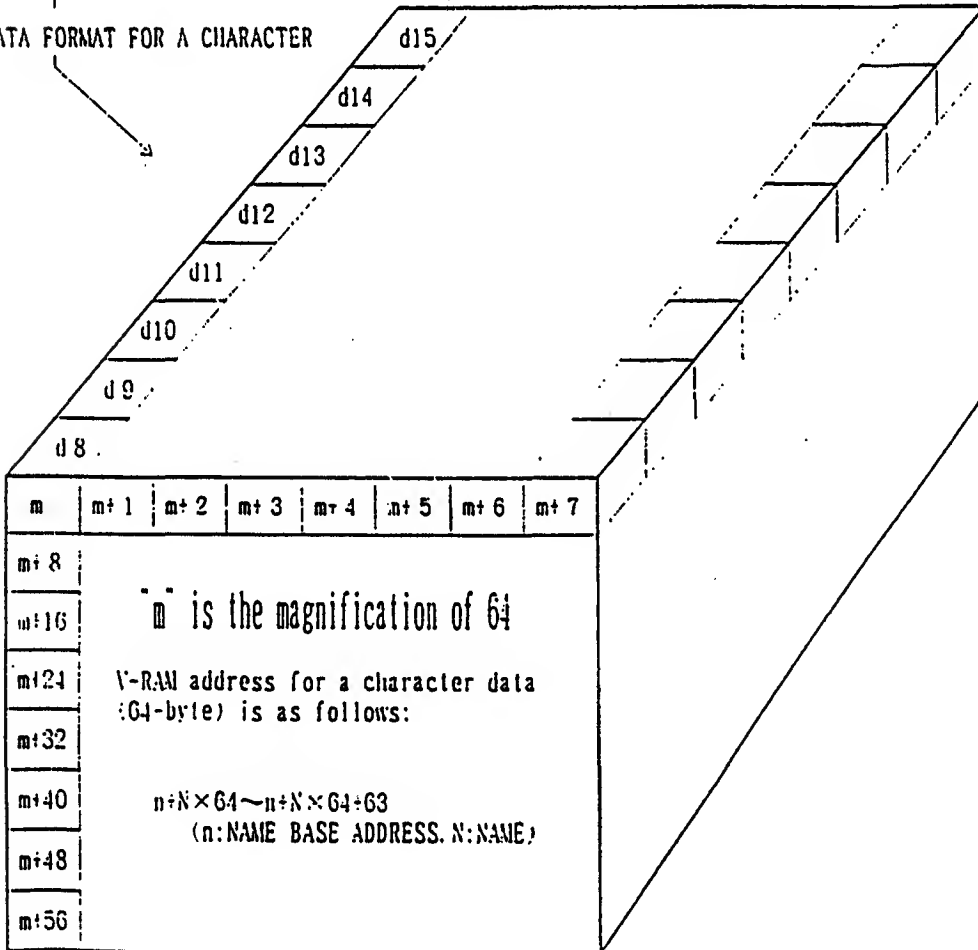


BG SC DATA (MODE 7)



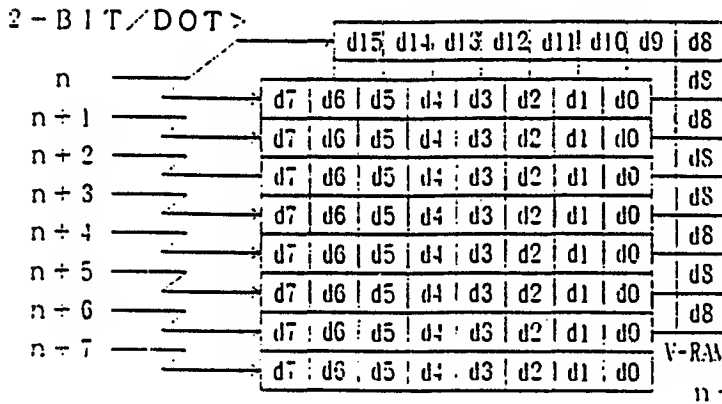
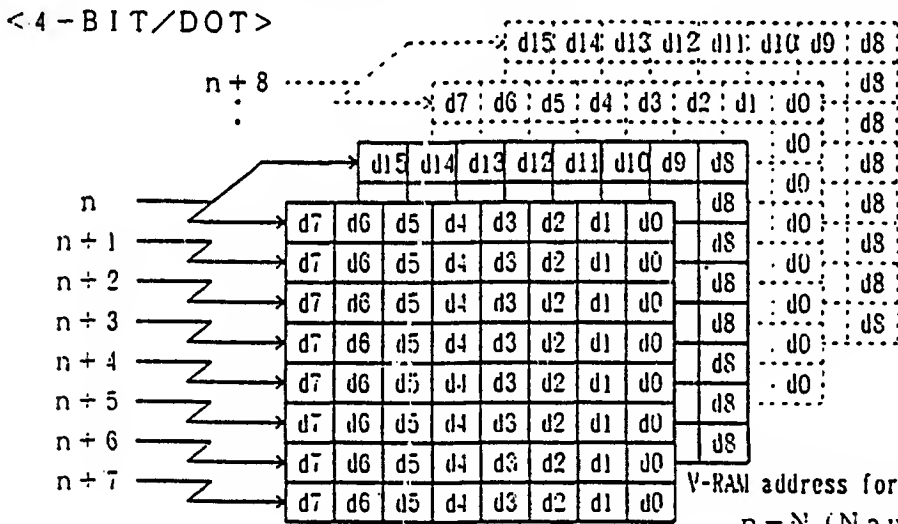
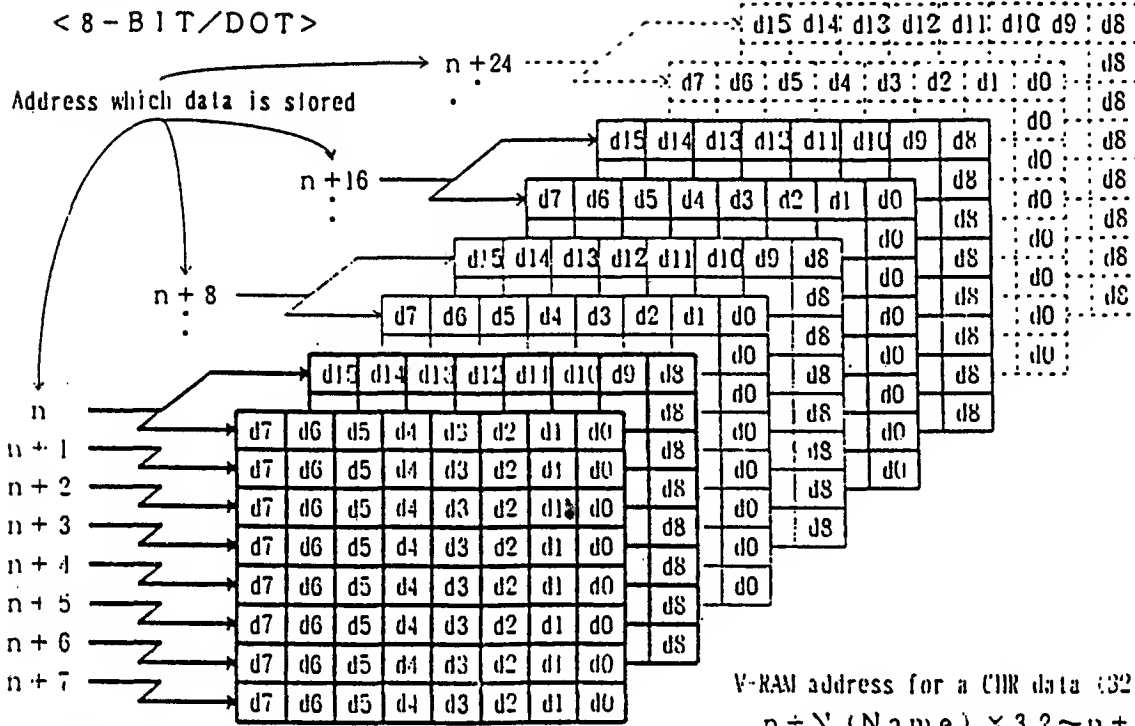
In case of EXTBG mode, D15 will be BG order (Display Priority Order).

DATA FORMAT FOR A CHARACTER



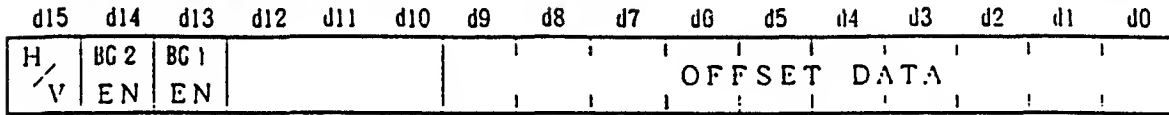
CHR DATA CONSTRUCTION

※ n : Name Base Address



OFFSET CHANGE MODE

The offset change mode can be used in the BG mode 2, 4 and 6, and the following data is required in this mode.



H, V OFFSET VALUE (in the change mode)

In case of the H-OFFSET, the data (D0 ~D2) will be invalid.

In case of the character (16 x 16), "D3" is effective every 3rd.

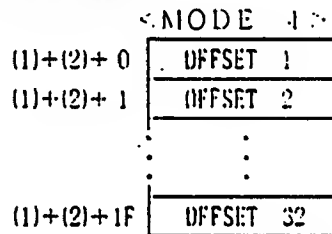
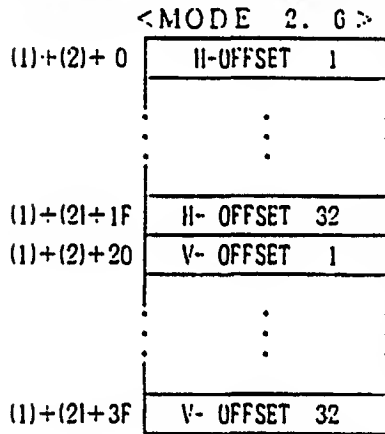
OFFSET MODE ENABLE

- 0 : Disable
- 1 : Enable

Designate either H-OFFSET or V-OFFSET for the OFFSET data D0 ~D9. (Only BG MODE 4 is effective)

- 0 : H-OFFSET
- 1 : V-OFFSET

This data should be written to the address, which is designated by "BG3 SC BASE ADDRESS" of register <2109H>, using the mode designated. (See below)

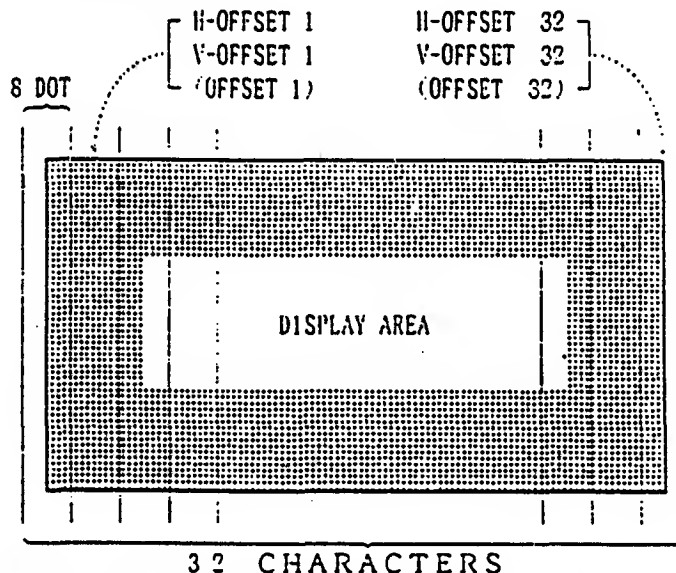


In case BG3 SC size is S1=0, S0=0

(1): BG3 SC Base Address ((value set by "d2"~"d7" of <2109H>) \times 1024)

(2): BG3 SC Offset Address ((value set by "d3"~"d7" of <2112H>) \times 32.

+ ((value set by "d3"~"d7" of <2111H>).

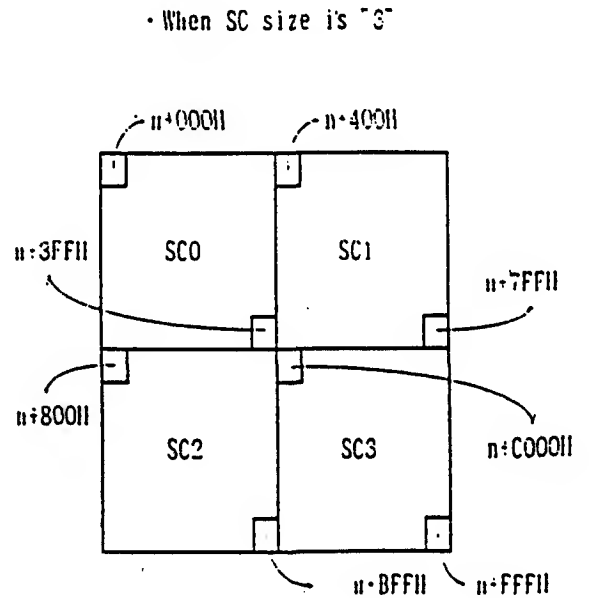
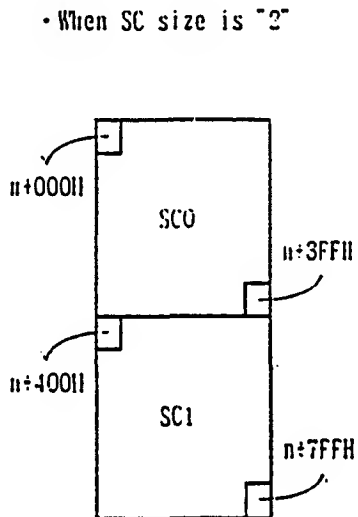
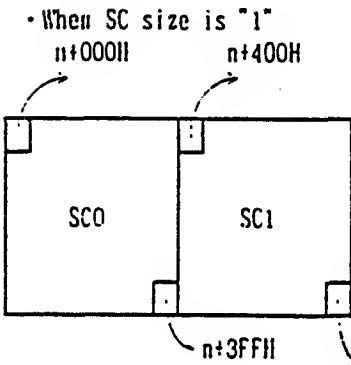
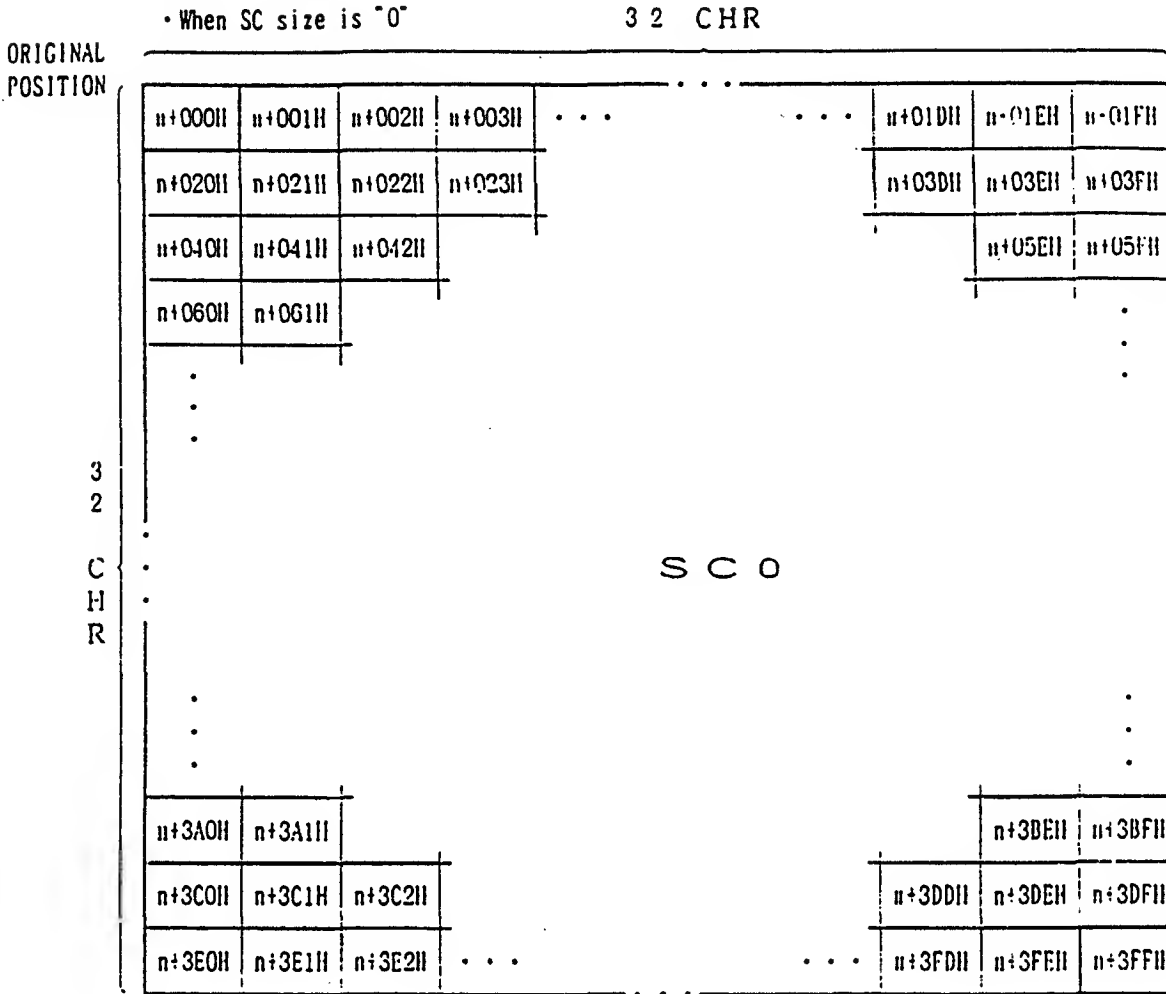


The offset value can be changed by each column (character unit).

Up to 3rd character can be seen horizontally on the screen by setting the offset value of the entire screen, but the offset can not be changed for 1st character (0 character).

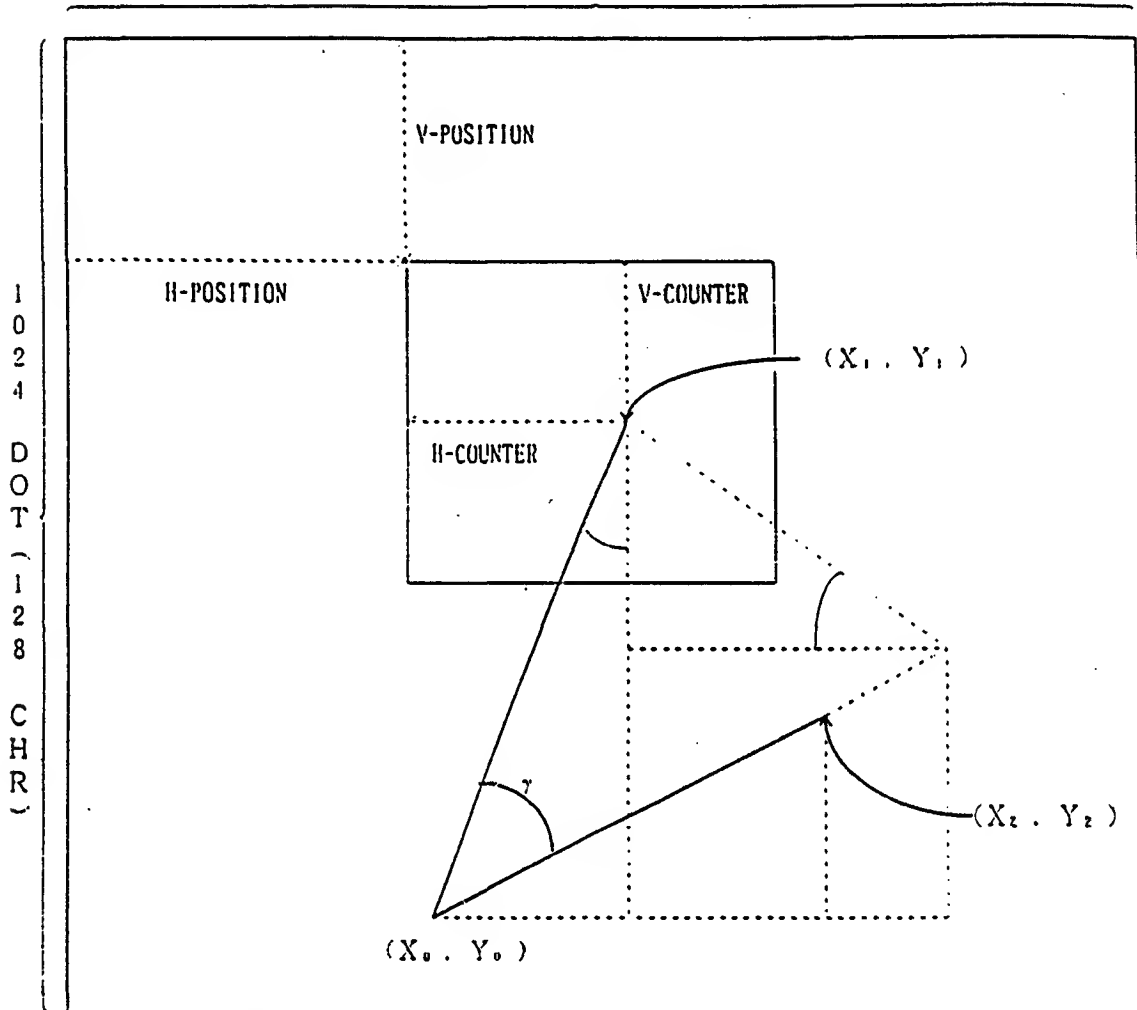
BG SCREEN

(n = SC Base Address(6-BIT) x 400H)



OPERATION (ROTATION/ENLARGEMENT/REDUCTION)

1024 DOT (128 CHR)



ROTATIONAL TRANSFORM FORMULA

$$\begin{bmatrix} X_2 \\ Y_2 \end{bmatrix} = \begin{bmatrix} \cos \gamma & \sin \gamma \\ -\sin \gamma & \cos \gamma \end{bmatrix} \begin{bmatrix} X_1 - X_0 \\ Y_1 - Y_0 \end{bmatrix} + \begin{bmatrix} X_0 \\ Y_0 \end{bmatrix}$$

X_0, Y_0 : Center Coordinate

X_1, Y_1 : Display Coordinate

X, Y : Coordinate before calculation of display coordinate

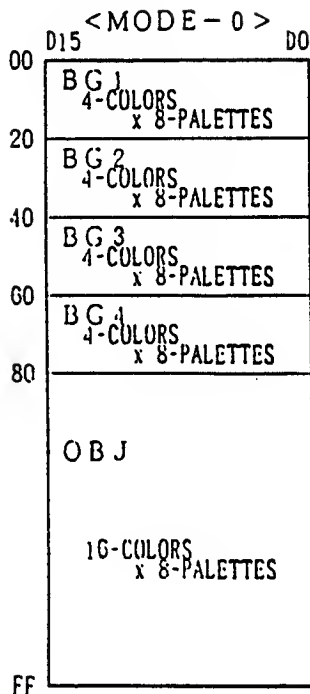
If the reduction rates for X-dir (α) and the reduction rates for Y-dir (β) are considered, the formula described above will be as follows :

$$\begin{bmatrix} X_2 \\ Y_2 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} X_1 - X_0 \\ Y_1 - Y_0 \end{bmatrix} + \begin{bmatrix} X_0 \\ Y_0 \end{bmatrix}$$

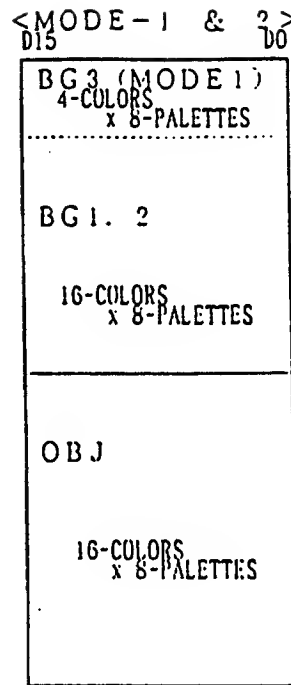
$A = \cos \gamma \times (1/\alpha)$, $B = \sin \gamma \times (1/\alpha)$

$C = -\sin \gamma \times (1/\beta)$, $D = \cos \gamma \times (1/\beta)$

CG-RAM



• 4-Screens for BG



<MODE-1>

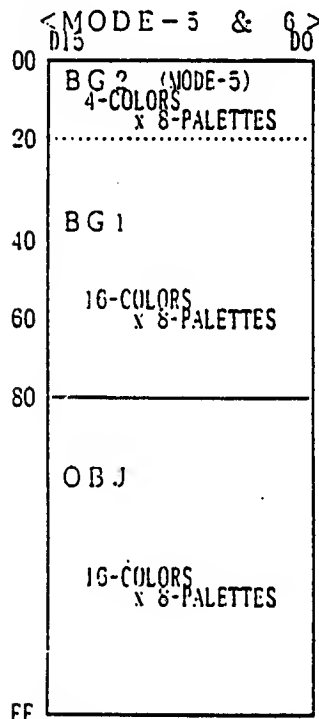
• 3-Screens for BG

• BG1 & 2 color data are held in common in the range of 0~7F
• BG3 color data are held in common in the range of 0~1F

<MODE-2>

• 2-Screens for BG

• BG1 & 2 color data are held in common in the range of 0~7F



<MODE-5>

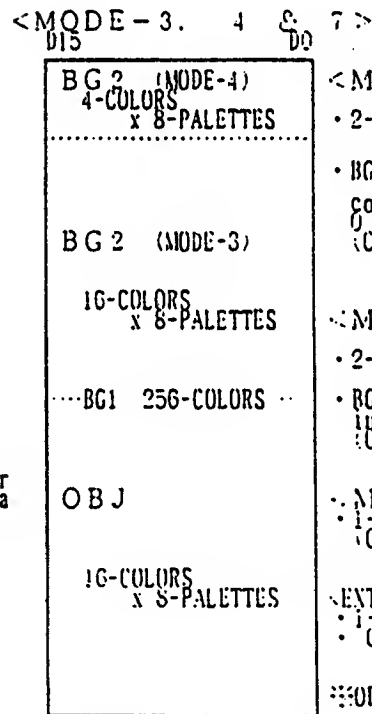
• 2-Screens for BG

• BG1 & 2 color data are held in common in the range of 0~1F

<MODE-6>

• 1-Screen for BG

• 0~7F are used just for BG1 color data



<MODE-3>

• 2-Screens for BG

• BG2 color data are held in common in the range of 0~1F (CG Direct select is excluded)

<MODE-4>

• 2-Screens for BG

• BG2 color data are in common in the range of 0~1F. (CG Direct select is excluded.)

<MODE-7>

• 1-Screen for BG

• (CG Direct select is excluded.)

• EXTBG ON MODE-7:

• 1-Screen for BG

• 0~7F are used just for BG2 color data

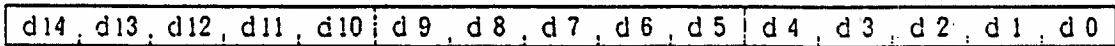
• OBJ is held in common with BG-1.

CG-RAM COLOR DATA

BLUE

GREEN

RED

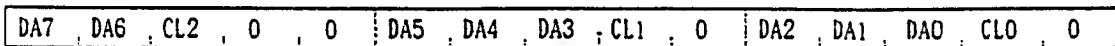


DIRECT SELECT COLOR DATA

BLUE

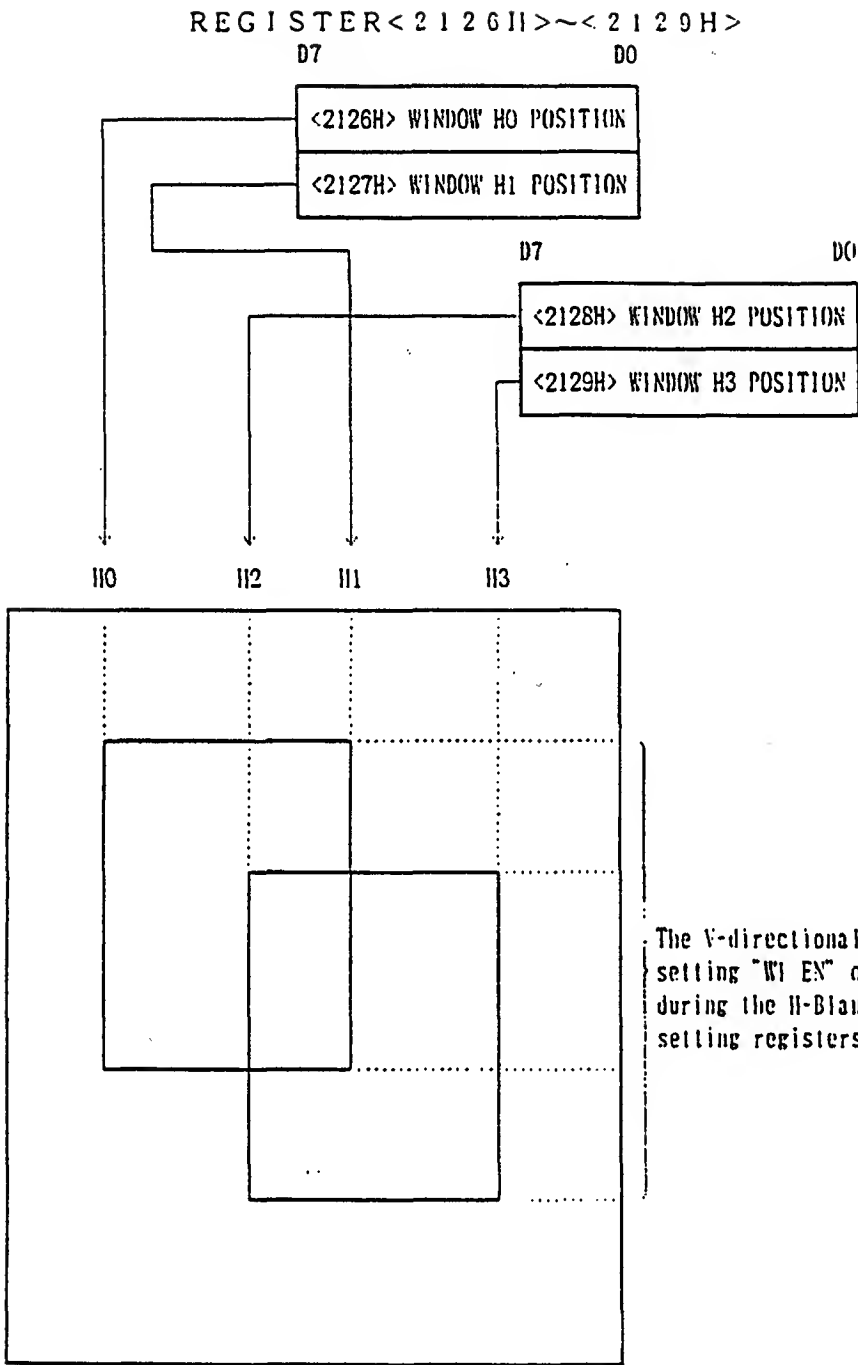
GREEN

RED



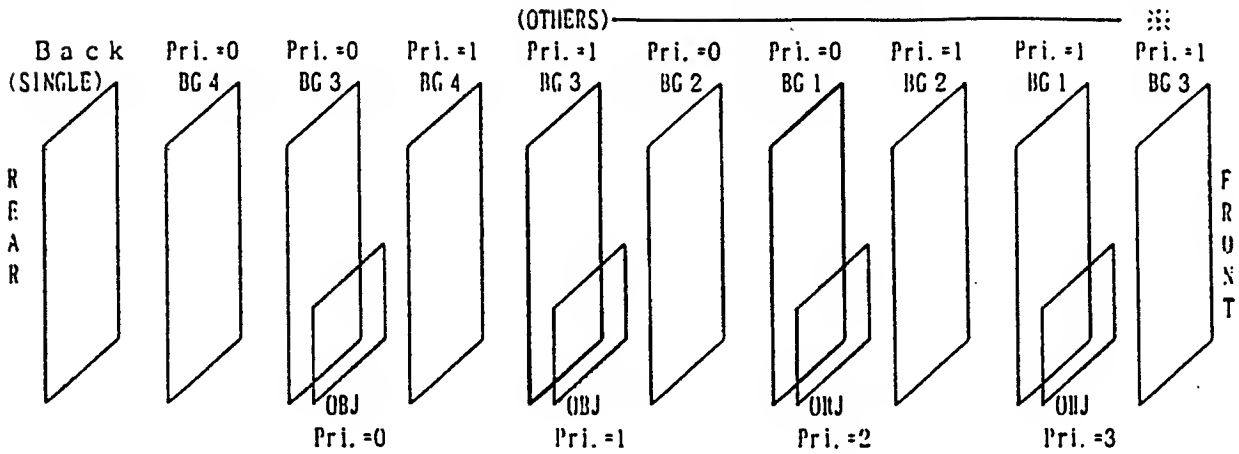
NOTE : DA0~DA7 are used for the character dot data. CL0~CL2 are used for the BG-SC data of the color. However, in case of Mode-7, CL0~CL2 should be '0'.
NOTE : If they are '0', it becomes transparent. The color of CG-RAM address '00H' will be background.

WINDOW

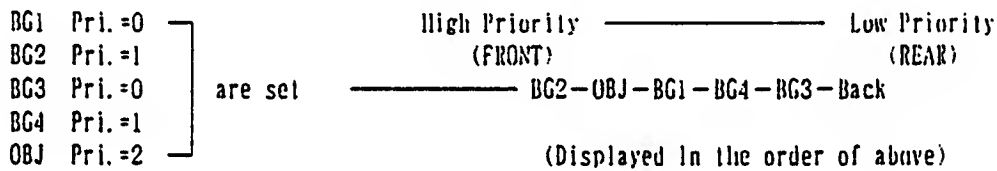


BG & OBJ PRIORITY

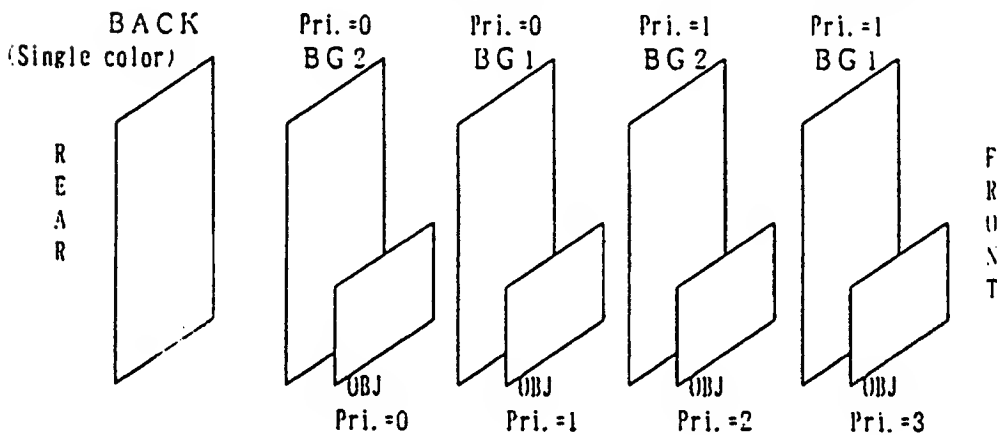
4-SCREEN/3-SCREEN MODE ※ In case "D3=1" is selected by register <2105H> in the mode-1



<Example of Display Priority (in case of mode 0 & 4)>



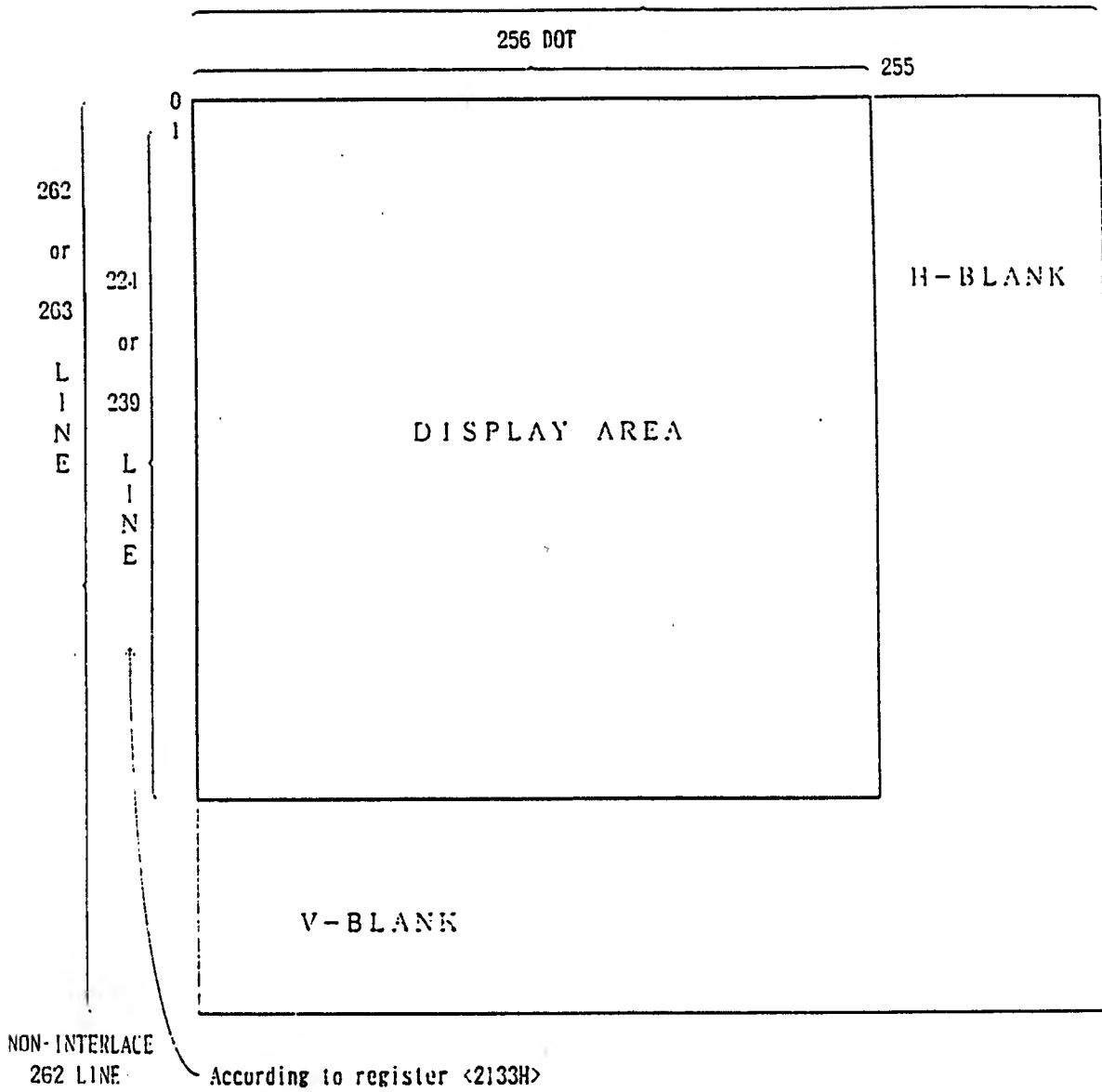
2-SCREEN/1-SCREEN MODE
 (in case Mode 2~7 is selected by the register <2105H>)



NOTE : In case of the display priority between the OBJs, normally the lower numbered OBJ will be displayed as higher priority. (See Page-35 for exception)
 This display priority will be determined before the priority between OBJ and BG is determined.

SCREEN

APPOX. 63.5 μ s

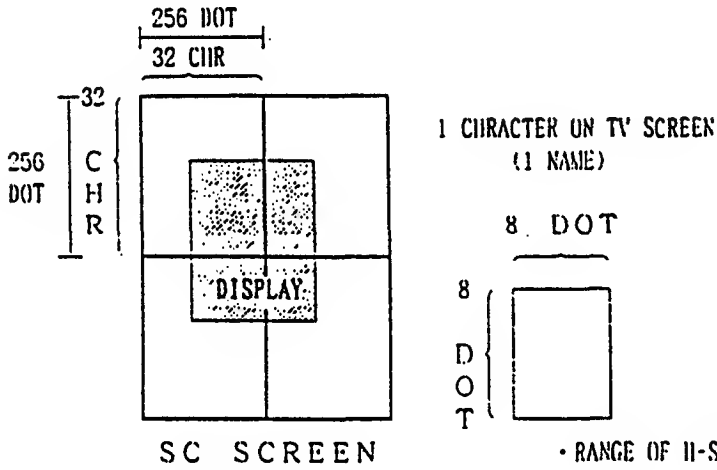


BG SCREEN

H/V SCROLL Ⓞ (Scroll range by the combination of modes. and SC size against screen)
 <Example in case SC size is "3" (SEE NO.4)>

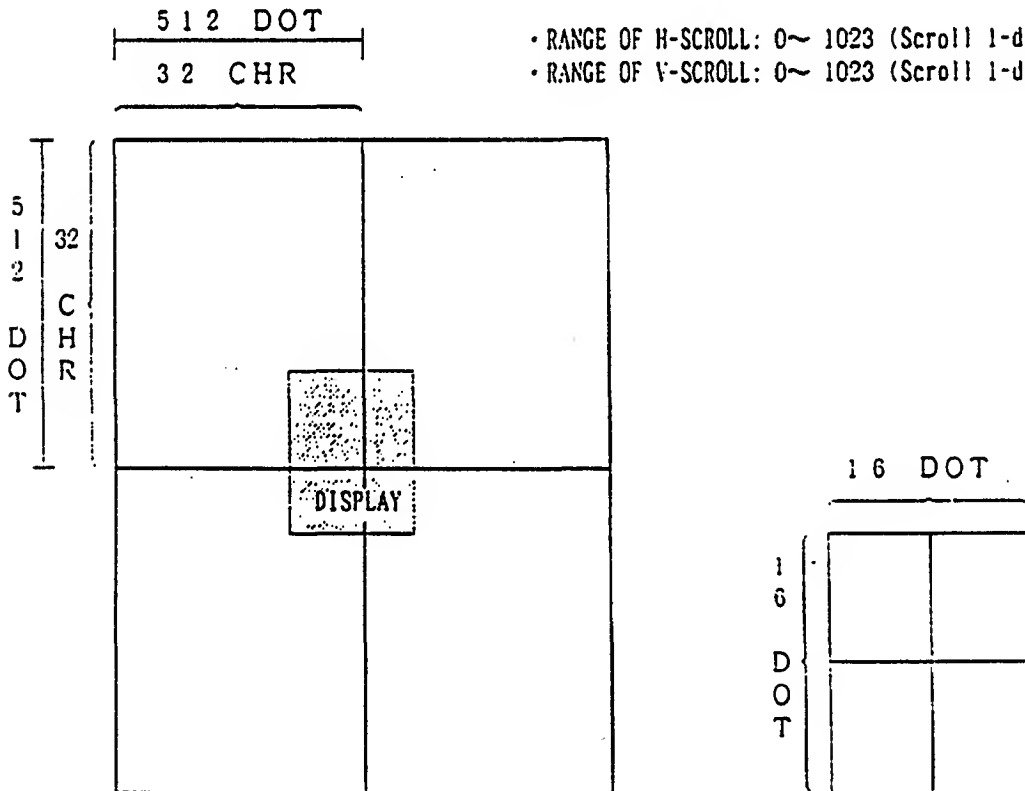
★In case of 0, 1, 2 & 4

• BG SIZE (8 x 8)



- RANGE OF H-SCROLL: 0~ 511 (Scroll 1-dot to the left by adding 1)
- RANGE OF V-SCROLL: 0~ 511 (Scroll 1-dot to the up by adding 1)

• BG SIZE (16 x 16)

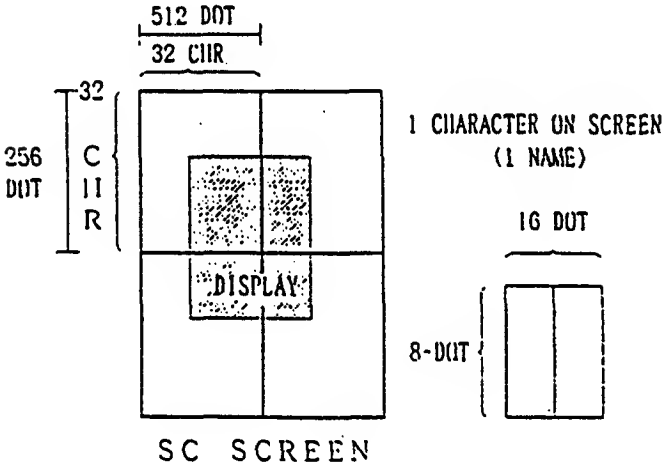


- RANGE OF H-SCROLL: 0~ 1023 (Scroll 1-dot to the left by adding 1)
- RANGE OF V-SCROLL: 0~ 1023 (Scroll 1-dot to the up by adding 1)

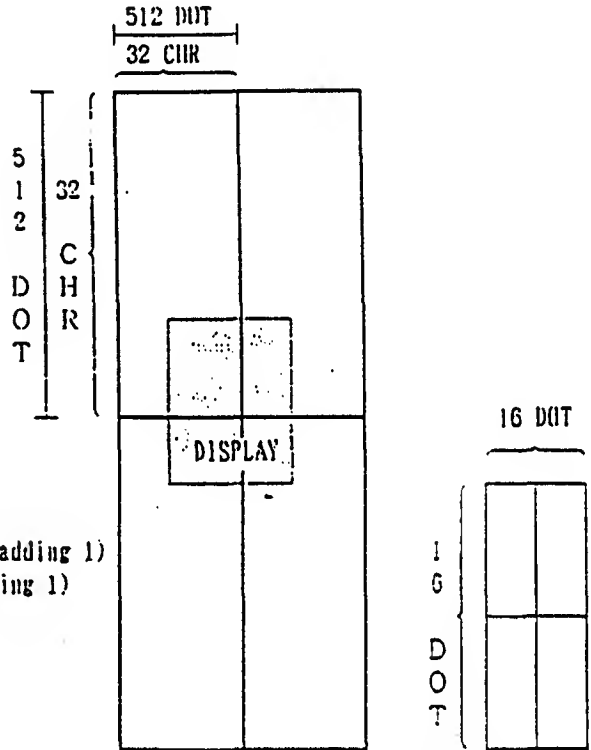
BG SCREEN

H/V SCROLL (2) (Scroll range by the combination of modes, and SC size against screen)
 <Example in case SC size is "3" (SEE NO.4)>

★ IN CASE OF MODE-5, MODE-6 & NON-INTERLACE
 • BG SIZE [8 x 8]



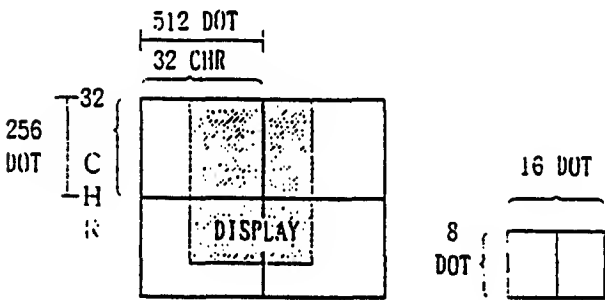
• BG SIZE [16 x 16]



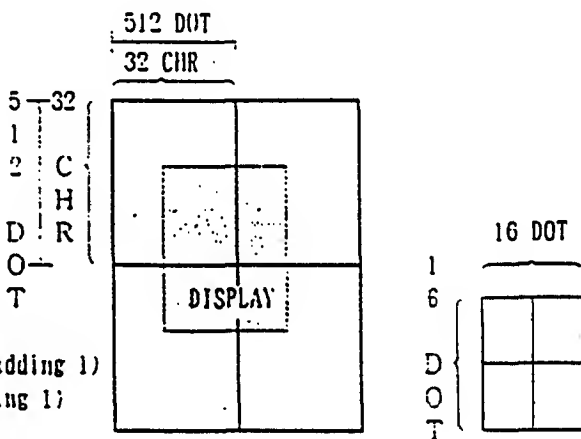
- RANGE OF H-SCROLL: 0 ~ 511 (Scroll 2-dots to the left by adding 1)
- RANGE OF V-SCROLL: 0 ~ 511 (Scroll 1-dot to the up by adding 1)

- RANGE OF H-SCROLL: 0 ~ 511 (Scroll 2-dots to the left by adding 1)
- RANGE OF V-SCROLL: 0 ~ 1023 (Scroll 1-dot to the up by adding 1)

★ IN CASE OF MODE-5 & 6, INTERLACE
 • BG SIZE [8 x 8]



• BG SIZE [16 x 16]



- RANGE OF H-SCROLL: 0 ~ 511 (Scroll 2-dots to the left by adding 1)
- RANGE OF V-SCROLL: 0 ~ 511 (Scroll 1-dot to the up by adding 1)

- RANGE OF H-SCROLL: 0 ~ 511 (Scroll 2-dots to the left by adding 1)
- RANGE OF V-SCROLL: 0 ~ 1023 (Scroll 1-dot to the up by adding 1)



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